

Marta Karas, MS, PhD

CONTACT INFORMATION

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Google Scholar

PROFILE

STATISTICAL METHODS interests: methods for processing and analysis of data from digital devices (wearable accelerometers, ambulatory blood pressure monitors, respiratory monitors, polysomnography), power estimation in complex settings, functional data analysis methods, R software development.

EDUCATION

Johns Hopkins University, Baltimore, MD, USA

Ph.D., Biostatistics

Aug 2017 – Dec 2021

- Dissertation: “Statistical Methods for Wearable Device Data and Sample Size Calculation in Complex Models.” (*Defense slides link*). Public final oral defense held on Nov 17, 2021.
- Academic Advisors: Ciprian M. Crainiceanu, Jacek K. Urbanek

Wrocław University of Science and Technology, Wrocław, Poland

M.S., Mathematics (specialization: Statistical Mathematics)

Oct 2013 – Jul 2015

- Dissertation: “Theoretical and practical issues in change point detection.” (*Thesis link*)
- Academic Advisor: Malgorzata Bogdan
- Final grade: 5.5/5.5 (Excellent). Graduation with Academic Distinction

Wrocław University of Science and Technology, Wrocław, Poland

B.S., Mathematics

Oct 2010 – Jul 2013

- Final grade: 5.0/5.5 (Very good)
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INDUSTRY EXPERIENCE

Takeda (Pharmaceutical), Cambridge, MA, USA

Senior Manager, Statistics

Jan 2022 - Present

- Provided subject matter expertise to asset studies across multiple therapeutic areas by offering guidance on digital endpoints selection, drafting protocol sections, Statistical Analysis Plans (SAPs) sections, and Biomarker Analysis Plans (BAPs) for the digital endpoints.
- Designed and conducted multiple statistical analyses on digital devices data from assets trials and novel digital technology evaluation trials.
- Developed a part of data preprocessing pipeline for SAP digital endpoints derivation.
- Supervised interns on proposed scientific research projects.
- Actively engaged with external experts in the digital health community by leading publications and participating in key conferences.
- Actively contributed to internal methodology hub focused on statistical methodologies for decentralized clinical trial.

Evidation Health (Digital Health), San Mateo, CA, USA

Data Science Intern

Jun 2020 - Aug 2020

- Designed, performed, and reported analysis to estimate post-surgery recovery trajectories and predict recovery time from wearable patient-generated health data (*first-author article published*).
- Proposed and implemented an extension of the existing methodology for quantifying sedentary/active accumulation time.

Novartis (Pharmaceutical), Basel, Switzerland

Sensor Data Analytic Intern

Jun 2019 - Aug 2019

- Proposed, implemented, and evaluated a method for free-living walking strides segmentation from wrist-worn accelerometry sensor (*first-author article published*).
- Quantified association between walking features and PROs in a diseased population.

Opera Software (Software, Web Browser), Wroclaw, Poland

Analyst (full-time)

**Aug 2016 - Dec 2016,
Jul 2015 - Dec 2015**

- Designed and implemented methodology for A/B-test results analysis.
- Developed time-series forecasting models for Opera browser's KPIs.
- Performed ad hoc user base analysis for software product improvements.
- Designed and implemented a Bayesian framework for inference about users' behavior.

Datarino (Big Data Services & Data Management Solutions), Wroclaw, Poland

Data Scientist (part-time)

Jul 2014 - Mar 2015

- Performed ad hoc analysis of user base and monetization KPIs of Polish social network service.
- Performed analyses of business partners' big-data size data sets.

ACADEMIC
EXPERIENCE

Harvard University, Department of Biostatistics, Harvard T.H. Chan School of Public Health, Boston, MA, USA

Postdoctoral Researcher

Jan 2022 - Dec 2022

- Conducted statistical analyses of data collected with wearable devices (ActiGraph, Modus) and smartphones (surveys, accelerometry, GPS) for digital phenotyping in ALS and in population with suicidal behavior. Co-authored four papers, out of which three were first- or co-first-authored.

Johns Hopkins University, Department of Biostatistics, Bloomberg School of Public Health, Baltimore, MD, USA

Research Assistant

Jun 2018 - Dec 2021

- Developed and validated ADEPT, a novel statistical pattern-segmentation method, optimized for identification of walking from wrist-worn accelerometry data.
- Proposed harmonization methods of objective summary measures of physical activity, applied to a large (n=600+) multiday observational study.
- Evaluated and expanded scope of novel resampling method for estimating statistical test power sample size in complex modeling settings, including multilevel data problems.
- Developed four open-source software (R packages). Two of them were incorporated in the Accelerometry Resource Core (ARC) at Johns Hopkins Medicine.

Indiana University Bloomington, Department of Epidemiology and Biostatistics, School of Public Health, Bloomington, IN, USA

Research Assistant

Jan 2017 - Jul 2017

- Applied graph-constrained regularization methods to quantify the association between brain structural imaging markers and HIV+/HIV- status (*article published*).

Indiana University – Purdue University Indianapolis, Department of Biostatistics, Richard M. Fairbanks School of Public Health, Indianapolis, IN, USA

Research Assistant

Jan 2016 - Jul 2016

- Proposed, implemented and evaluated extension of existing graph-constrained regularization methods for linear regression (*first-author article published*).
- Quantified association between brain structural imaging markers and alcohol abuse.

HONORS AND
AWARDS

1. Induction as a member of the Alpha chapter of the Delta Omega Society. 2022 ([link](#))
2. Travel Reimbursement Award to 3rd Annual Health Data Science Symposium at Harvard. Harvard University. 2021
3. Student Poster Sponsorship for the ActiGraph Digital Data Summit 2021. ActiGraph LLC. 2021
4. Louis I. and Thomas D. Dublin Award for the Advancement of Epidemiology and Biostatistics. Johns Hopkins University, Department of Biostatistics and Department of Epidemiology. 2021 ([link](#))
5. Helen Abbey Award for Excellence in Teaching. Johns Hopkins University, Department of Biostatistics. 2021 ([link](#))
6. Joseph Zeger Travel Reimbursement Award to CFE-CMStatistics 2020 conference. Johns Hopkins University, Department of Biostatistics. 2020
7. Joseph Zeger Travel Reimbursement Award to ICAMPAM 2019 conference. Johns Hopkins University, Department of Biostatistics. 2019
8. Leadership, Empowerment and Learning Culture Award. Novartis US Analytics Conference. 2019
9. ENAR Poster Award. ENAR 2017 Spring Meeting. 2017
10. The 2nd Summer Institute in Statistics for Big Data Scholarship Award. University of Washington, Department of Biostatistics. 2016

PUBLISHED
JOURNAL ARTICLES

1. **Karas, M.***, Olsen, J.*, Straczewicz, M., Johnson, S. A., Burke, K. M., Iwasaki, S., Lahav, A., Scheier, Z. A., Clark, A. P., Iyer, A. S., Huang, E., Berry, J. D., Onnela, J.-P. (2024). Tracking amyotrophic lateral sclerosis disease progression using passively collected smartphone sensor data. *Annals of Clinical and Translational Neurology*, 11(6), 1380–1392. <https://doi.org/10.1002/acn3.52050>
2. Straczewicz, M., **Karas, M.**, Johnson, S. A., Burke, K. M., Scheier, Z., Royse, T. B., Calcagno, N., Clark, A., Iyer, A., Berry, J. D., Onnela, J.-P. (2024). Upper limb movements as digital biomarkers in people with ALS. *eBioMedicine*, 101. <https://doi.org/10.1016/j.ebiom.2024.105036>
3. Latzman, R. D., Campagne, O., Modi, M. E., **Karas, M.**, Malanga, C. J., Whiteman, D. A. H. (2024). Advancing clinical development for neuronopathic Hunter syndrome through a

- quantitatively-driven reverse translation framework. *Clinical and Translational Science*, 17(4), e13776. <https://doi.org/10.1111/cts.13776>
4. Johnson, S. A.*, **Karas, M.***, Burke, K. M., Strackiewicz, M., Scheier, Z. A., Clark, A. P., Iwasaki, S., Lahav, A., Iyer, A. S., Onnela, J.-P., Berry, J. D. (2023). Wearable device and smartphone data quantify ALS progression and may provide novel outcome measures. *Npj Digital Medicine*, 6(1), 34. <https://doi.org/10.1038/s41746-023-00778-y>
 5. Matabuena, M.*, **Karas, M.***, Riazati, S., Caplan, N., Hayes, P. R. (2023). Estimating knee movement patterns of recreational runners across training sessions using multilevel functional regression models. *The American Statistician*, 77(2), 169–181. <https://doi.org/10.1080/00031305.2022.2105950>
 6. Neishabouri, A., Nguyen, J., Samuelsson, J., Guthrie, T., Biggs, M., Wyatt, J., Cross, D., **Karas, M.**, Migueles, J.H., Khan, S., Guo, C.C. (2022). Quantification of acceleration as activity counts in ActiGraph wearable. *Scientific Reports*, 12(1), 1–8. <https://doi.org/10.1038/s41598-022-16003-x>
 7. **Karas, M.***, Muschelli, J.*, Leroux, A., Urbanek, J. K., Wanigatunga, A. A., Bai, J., Crainiceanu, C. M., Schrack, J. A. (2022). Comparison of Accelerometry-Based Measures of Physical Activity: Retrospective Observational Data Analysis Study. *JMIR mHealth and uHealth*, 10(7), e38077. <https://doi.org/10.2196/38077>
 8. Rubin, D.S., Ranjeva, S.L., Urbanek, J.K., **Karas, M.**, Madariaga, M.L.L., Huisingh-Scheet, M. (2022). Smartphone based gait cadence to identify older adults with decreased functional capacity. *Digital Biomarkers*, 6(2), 61–70. <https://doi.org/10.1159/000525344>
 9. Urbanek, J. K., Roth, D. L., **Karas, M.**, Wanigatunga, A. A., Mitchell, C. M., Juraschek, S. P., Cai, Y., Appel, L. J., Schrack, J. A. (2022). Free-living gait cadence measured by wearable accelerometer: a promising alternative to traditional measures of mobility for assessing fall risk. *The Journals of Gerontology: Series A*, 2022;, glac013, <https://doi.org/10.1093/gerona/glac013>
 10. **Karas, M.**, Urbanek, J. K., Illiano, V. P., Bogaarts, G., Crainiceanu, C. M., Dorn, J. F. (2021). Estimation of free-living walking cadence from wrist-worn sensor accelerometry data and its association with SF-36 quality of life scores. *Physiological Measurement*, 42(6), 65006. <https://doi.org/10.1088/1361-6579/ac067b>
 11. Brzyski, D., **Karas, M.**, M Ances, B., Dziedzic, M., Goñi, J., W Randolph, T., Harezlak, J. (2021). Connectivity-informed adaptive regularization for generalized outcomes. *Canadian Journal of Statistics*, 49(1), 203–227. <https://doi.org/10.1002/cjs.11606>
 12. **Karas, M.**, Marinsek, N., Goldhahn, J., Foschini, L., Ramirez, E., Clay, I. (2020). Predicting Subjective Recovery from Lower Limb Surgery Using Consumer Wearables. *Digital Biomarkers*, 4(Suppl 1), 73–86. <https://doi.org/10.1159/000511531>
 13. **Karas, M.**, Strackiewicz, M., Fadel, W., Harezlak, J., Crainiceanu, C. M., Urbanek, J. K. (2021). Adaptive empirical pattern transformation (ADEPT) with application to walking stride segmentation. *Biostatistics (Oxford, England)*, 22(2), 331–347. <https://doi.org/10.1093/biostatistics/kxz033>
 14. **Karas, M.**, Bai, J., Strackiewicz, M., Harezlak, J., Glynn, N. W., Harris, T., Zipunnikov, V., Crainiceanu, C., Urbanek, J. K. (2019). Accelerometry Data in Health Research: Challenges and Opportunities. *Statistics in Biosciences*, 11(2), 210–237. <https://doi.org/10.1007/s12561-018-9227-2>
 15. **Karas, M.**, Brzyski, D., Dziedzic, M., Goñi, J., Kareken, D. A., Randolph, T. W., Harezlak, J. (2017). Brain Connectivity-Informed Regularization Methods for Regression. *Statistics in Biosciences*, 11(1), 47–90. <https://doi.org/10.1007/s12561-017-9208-x>

ACCEPTED
JOURNAL ARTICLES

1. **Karas, M.**, Huang, D., Clement, Z., Millner, A.J., Kleiman, E.M., Bentley, K.H., Zuromski, K.L., Fortgang, R.G., DeMarco, D., Haim, A., Donovan, A., Buonopane, R.J., Bird, S.A., Smoller, J.W., Nock, M.K., Onnela, J-P. Smartphone screen time characteristics in people with suicidal thoughts: retrospective observational data analysis study. (2024). Accepted in *JMIR mHealth and uHealth*.

PREPRINTS

1. Pilkar, R., Gerstel, D., Toole, E., Biggs, M., Guthrie, T., **Karas, M.**, Moufawad el Achkar, C., Renevey, P., Soltani, A., Sloan, S., Nguyen, J., Patterson, M.R., Ferrario, D., Lemay, M., Neishabouri, A., Guo, C. (2022). Performance analyses of step-counting algorithms using wrist accelerometry. Preprint available on *Research Square*. <https://doi.org/10.21203/rs.3.rs-2183645/v1>
2. **Karas, M.**, Crainiceanu, C. M. (2021). Upstrap for estimating power and sample size in complex models. Preprint available on *bioRxiv*. <https://doi.org/10.1101/2021.08.21.457220>

Note: * indicates shared co-first authorship, + indicates shared co-last authorship.

CONFERENCE /
INVITED TALKS
(SELECTED)

1. *Innovative approaches to sensor measurements in patients with ALS*. Digital Health and AI innovation Summit, Boston, MA, Oct 2024 (upcoming).
 2. *Functional regression methods for estimating 24-hour ambulatory blood pressure and heart rate parameters in narcolepsy type 1*. JSM 2024, Portland, OR, Aug 2024.
 3. *Wearable device and smartphone data for tracking ALS disease progression*. Digital Health Innovation Summit, San Francisco, CA, Jul 2023.
 4. *Comparison of accelerometry-based measures of physical activity*. JSM 2022, Washington, D.C., Aug 2022.
 5. *Harmonization of open-source and proprietary accelerometry-based physical activity measures*. 3rd Annual Health Data Science Symposium at Harvard, Boston, Nov 2021.
 6. *Estimation of free-living walking cadence from wrist-worn sensor accelerometry data and its association with SF-36 quality of life scores*. ENAR 2021, virtual conference, Mar 2021.
 7. *Estimation of free-living walking cadence from wrist-worn sensor accelerometry data and its association with SF-36 quality of life scores*. CMStatistics 2020, virtual conference, Dec 2020.
 8. *Novel approach for precise walking cadence estimation from high-density tri-axial accelerometry data collected at wrist in free-living*. 41st Annual Conference of the International Society for Clinical Biostatistics, virtual conference, Aug 2020.
 9. *Functional registration of walking strides in high-density accelerometry data for estimation of gait asymmetry*. CFE-CMStatistics 2019 conference, London, UK, Dec 2019.
 10. *Walking measurements derived from free-living wrist-worn sensor as novel digital endpoints*. Novartis 2019 US Analytics Conference, East Hanover, NJ, USA, Oct 2019.
 11. *Automatic estimation of step asymmetry from accelerometry data*. ICAMPAM 2019, Maastricht, The Netherlands, Jul 2019.
 12. *ADaptive Empirical Pattern Transformation (ADEPT) with application to walking stride segmentation*. JSM 2018, Vancouver, Canada, Aug 2018.
 13. *Wearable accelerometers, accelerometry data and automatic steps segmentation in R: strideter and convo R packages*. Why R? 2018 Conference, Wroclaw, Poland, Jul 2018.
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CONFERENCE
POSTERS

1. *Wearable devices can track ALS disease progression and may serve as novel clinical trial outcome measures.* ActiGraph Digital Data Summit 2022, Pensacola Beach, FL, Nov 2022.
2. *Comparison of accelerometry-derived physical activity summary measures by age, sex, and BMI.* ICAMPAM 2021 virtual conference, Jun 2021.
3. *Association of Structural Brain Imaging Measures with HIV Markers Incorporating Structural Connectivity Information: a Regularized Statistical Approach.* ENAR, Washington DC, USA, Mar 2017. (Received ENAR Poster Award).
4. *Penalized regression inference regarding variable selection in high dimensions: presentation of selected methods implemented in R.* European R Users Conference, Poznan, Poland, Oct 2016.

SOFTWARE
DEVELOPMENT

1. **arctools** R package: Processing and Physical Activity Summaries of Minute Level Activity Data. (*CRAN*, *GitHub*)
2. **adept** R package: Adaptive Empirical Pattern Transformation. (*CRAN*, *GitHub*, *website*). (Selected in *Top 40 new CRAN packages* in May 2019; *list link*)
3. **adeptdata** R package: Accelerometry Data Sets. (*CRAN*, *GitHub*)
4. **runstats** R package: Fast Computation of Running Statistics for Time Series. (*CRAN*, *GitHub*, *website*)
5. **mdpeer** R package: Graph-Constrained Regression with Enhanced Regularization Parameters Selection. (*CRAN*)

PROFESSIONAL
ACTIVITIES

- Referee for: PLOS ONE, Digital Biomarkers, Gait and Posture, Journal for the Measurement of Physical Behaviour, Physiological Measurement, Scandinavian Journal of Medicine and Science in Sports, Sensors, Social and Personality Psychology Compass. (*Publons profile link*).

SOFTWARE
PROFICIENCY

- R, Python, Git.