

Data Collection Using Wearables, Sensors, and Apps in the Social, Behavioral, and Health Sciences

**Summer Institute in Survey Research Techniques
July 2024**

Course Times and Location

SURVMETH 988.016

July 9-30, 2024

This course has 4 units, as described in the syllabus below. The class schedule includes:

- 4-5 hours of self-guided class preparation per unit (videos, readings, exercises, online discussion forum)
- Class meetings by video from 11am-12:30pm EST each Tuesday (7/9, 7/16, 7/23, and 7/30)
- Presentation of individual/group projects during the class meetings

Instructors

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Overview and Goals of Course

The recent proliferation of mobile technology allows researchers to collect objective health and behavioral data at increased intervals, in real time, and may also reduce participant burden. In this course, we will provide examples of the utility and integration of wearables, sensors, and apps in research settings. Examples will include the use of wearable health devices to measure activity, apps for ecological momentary assessment, and smartphone sensors to measure sound and movement, among others. Additionally, this course will consider the integration of these new technologies into existing surveys and the quality of the data collected from the total survey error perspective. We will discuss considerations for assessing coverage, participation, and measurement error when integrating wearables, sensors, and apps in a research setting as well as the costs and privacy considerations when collecting these types of data. Participants will work in groups to discuss a research study design using new technology and have the opportunity for hands-on practice with sensor data.

Course Structure and Course Concept

This is an online course using a flipped classroom design. As a participant in this course, you are responsible for watching video-recorded lectures and reading the required literature for each unit and then attend four two-hour video-mediated online meetings where you will have the chance to further discuss the materials from a unit with the instructors and your peers. Although this is an online course where you have more freedom in when you engage with the course materials, you are expected to come

prepared to the online video meetings. While the course is spread out across two weeks, the overall workload in this course will be approximately equivalent to a two-day short course.

Course Materials

All course materials will be made available online one week in advance on the class website at <https://canvas.it.umich.edu/>. Course materials on the website include videos, lecture slides, readings, discussion forums, and other work materials for downloading.

Mandatory Online Meetings

There will be four two-hour video-mediated meetings in this course that will allow you to interact with the instructors and your peers. Meetings will be held online through Zoom. Follow the link to the meeting sessions on the course website.

In preparation for the online meetings, you are expected to watch the lecture videos and read the assigned literature before the start of the meeting. In addition, all participants are encouraged to post questions about the materials covered in the videos and readings of the unit in the discussion forum before the meetings.

Zoom Video Policy

We will use the Zoom video platform for our meetings (meetings will not be recorded). To facilitate discussions and foster an engaging and safe learning environment, students are encouraged to follow these suggestions when using Zoom in this course:

- Please sign in with your full first and last name. This makes it possible to know who attends and who is speaking.
- In general, please use a computer/laptop to access the meetings. Smartphones are okay but not ideal, given their small screens.
- Stay focused and engaged in class activities. Close any browser tabs and other apps on your device that are not relevant and turn off notifications during the meetings.
- Turn on your video when possible. It is helpful to be able to see each other, just as in an in-person class. If you have limited Internet bandwidth or no webcam, it is ok to not use video. You can use the [Virtual Background](#) function in Zoom if you do not want to share your actual background.
- Please mute your microphone when you are not talking. This helps eliminate background noise.
- Be in a quiet, distraction-free place when possible. Turn off any music, videos, etc. in the background.
- Use the chat window for questions and comments that are relevant to class. The chat window is not a place for socializing or posting comments that distract from the course activities. Private messaging will be disabled.
- Do not take any screenshots without explicit permission by all participants.

Evaluation

By default, this is a non-credit course. If you want to receive credit for participation in the course, you need to contact the instructors before the start of the course. Participants who seek credit will receive a take-home assignment due one week after the end of the course.

Accommodations for Students with Disabilities

If you think you need an accommodation for a disability, please contact Services for Students with Disabilities (SSD) office to help us determine appropriate academic accommodations. SSD (734-763-3000; <https://ssd.umich.edu/>) typically recommends accommodations through a Verified Individualized Services and Accommodations (VISA) form. Any information you provide is private and confidential and will be treated as such.

Academic conduct

Clear definitions of the forms of academic misconduct, including cheating and plagiarism, as well as information about disciplinary sanctions for academic misconduct may be found at the Rackham web site for the University of Michigan: <https://rackham.umich.edu/academic-policies/section8/>

Knowledge of these rules is your responsibility as a participant and ignorance of them does not excuse misconduct. As a participant, you are expected to be familiar with these guidelines before submitting any written work or taking any exams in this course. Lack of familiarity with these rules in no way constitutes an excuse for acts of misconduct. Charges of plagiarism and other forms of academic misconduct will be dealt with very seriously and may result in oral or written reprimands, a lower or failing grade on the assignment, a lower or failing grade for the course, suspension, and/or, in some cases, expulsion from the university.

Course Outline

Unit 1

Videos

- Introduction; Course overview
- What can we measure with wearables, sensors, & apps
- Technology & possible research questions

Recommended readings

- Doherty, A., Jackson, D., Hammerla, N., Plötz, T., Olivier, P., Granat, M. H., ... & Preece, S. J. (2017). Large scale population assessment of physical activity using wrist worn accelerometers: the UK biobank study. *PloS one*, 12(2), e0169649. <https://doi.org/10.1371/journal.pone.0169649>
- Harari, G. M., Lane, N. D., Wang, R., Crosier, B. S., Campbell, A. T., & Gosling, S. D. (2016). Using smartphones to collect behavioral data in psychological science: Opportunities, practical considerations, and challenges. *Perspectives on Psychological Science*, 11, 838-854. <https://doi.org/10.1177/1745691616650285>

- Keusch, F. & Conrad, F. (2022). Using smartphones to capture and combine self-reports and passively measured behavior in social research. *Journal of Survey Statistics and Methodology*, 10, 863-885. <https://doi.org/10.1093/jssam/smab035>
- Rezaei, N., Grandner, M.A. (2021). Changes in sleep duration, timing, and variability during the COVID-19 pandemic: Large-scale Fitbit data from 6 major US cities. *Sleep Health*, 7, 303-313. <https://doi.org/10.1016/j.sleh.2021.02.008>

Exercises

- Briefly introduce yourself to the class. What are your background and current affiliation? What research do you do? What experience do you have with sensors and apps, both for your own personal use and for research, if any?
- Develop a research question that can be answered using sensor data. Describe the target population and the type of data that would be used and any additional information you may need to collect to answer your research question.

Online Meeting

- Tue, July 9, 11am-12:30pm EST

Unit 2

Videos

- Study design considerations from the TSE perspective
- Practical implementation & operational considerations

Recommended readings

- Fingerman, K. L., Huo, M., Charles, S. T., & Umberson, D. J. (2020). Variety Is the Spice of Late Life: Social Integration and Daily Activity. *The Journals of Gerontology: Series B*, 75, 377-388. <https://doi.org/10.1093/geronb/gbz007>
- Kreuter, F., Haas, G. C., Keusch, F., Bähr, S., & Trappmann, M. (2020). Collecting survey and smartphone sensor data with an app: Opportunities and challenges around privacy and informed consent. *Social Science Computer Review*, 38, 533-549. <https://doi.org/10.1177/0894439318816389>
- All of Us Research Program Investigators. (2019). The “All of Us” research program. *New England Journal of Medicine*, 381, 668-676. <https://doi.org/10.1056/NEJMs1809937>

Exercise

- Using your initial research question, develop an operational plan for carrying out your research project. Describe your study population and methods. Consider potential sources of error.

Online Meeting

- Tue, July 16, 11am-12:30pm EST
- Overview of EMA/ESM

Unit 3

Videos

- Data from wearables, apps & sensors
- Errors when collecting, processing, and interpreting sensor data

Recommended readings

- Bähr, S., Haas, G.-C., Keusch, F., Kreuter, F., & Trappmann, M. (2022). Missing data and other measurement quality issues in mobile geolocation sensor data. *Social Science Computer Review.*, 40. 212-235. <https://doi.org/10.1177/0894439320944118>
- Kapteyn, A., Banks, J., Hamer, M., Smith, J.P., Steptoe, A., van Soest, A., Koster, A., & Htay Wah, S. (2018). What they say and what they do: comparing physical activity across the USA, England and the Netherlands. *Journal of Epidemiology and Community Health*, 72, 471-476. <http://dx.doi.org/10.1136/>

Exercise

- Using your initial research question, develop an operational plan for carrying out your research project. Describe your study population and methods. Consider potential sources of error. (We will continue with short presentations of those who we did not get to in our second meeting.)

Online Meeting

- Tue, July 23, 11am-12:30pm EST

Unit 4

Videos

- Working with data from wearables, apps, & sensors
- Additional resources

Recommended readings

- None

Exercise

- Explore some of the data from wearables, apps, and sensors
- Prepare one graph of an interesting finding from your exploratory data analysis for the video meeting
- Using your initial research question, develop an operational plan for carrying out your research project. Describe your study population and methods. Consider potential sources of error. (Continue from previous sessions, if needed.)

Online Meeting

- Tue, July 30, 11am-12:30pm EST

Additional Readings

Harari, G. M., Müller, S. R., Aung, M. S., & Rentfrow, P. J. (2017). Smartphone sensing methods for studying behavior in everyday life. *Current Opinion in Behavioral Sciences*, 18, 83-90. <https://doi.org/10.1016/j.cobeha.2017.07.018>

Huber, R. & Ghosh, A. (2021). Large cognitive fluctuations surrounding sleep in daily living. *iScience*, 24, 102159. <https://doi.org/10.1016/j.isci.2021.102159>.

Keusch, F., Struminskaya, B., Antoun, C., Couper, M. P., & Kreuter, F. (2019). Willingness to participate in passive mobile data collection. *Public Opinion Quarterly*, 83, 210-235. <https://doi.org/10.1093/poq/nfz007>

Li, X., Kawachi, I., Buxton, O. M., Haneuse, S., & Onnela, J. P. (2019). Social network analysis of group position, popularity, and sleep behaviors among US adolescents. *Social Science & Medicine*, 232, 417-426. <https://doi.org/10.1016/j.socscimed.2019.05.026>

MacKerron, G., & Mourato, S. (2013). Happiness is greater in natural environments. *Global Environmental Change*, 23, 992-1000. <https://doi.org/10.1016/j.gloenvcha.2013.03.010>

Mapes, B. M., Foster, C. S., Kusnoor, S. V., Epelbaum, M. I., AuYoung, M., Jenkins, G., ... & All of Us Research Program. (2020). Diversity and inclusion for the All of Us research program: A scoping review. *PloS one*, 15(7), e0234962. <https://doi.org/10.1371/journal.pone.0234962>

Myin-Germeys, I. & Kuppens, P. (Eds.). (2022). *The open handbook of experience sampling methodology: A step-by-step guide to designing, conducting, and analyzing ESM studies*. Second Edition. Leuven: Center for Research on Experience Sampling and Ambulatory Methods Leuven. <https://www.kuleuven.be/samenwerking/real/real-book/index.htm>

Master, H., Annis, J., Huang, S., Beckman, J.A., Ratsimbazafy, F., Marginean, K,... & Brittain, E.L. (2022). Association of step counts over time with the risk of chronic disease in the All of Us Research Program. *Nature Medicine*, 28, 2301-2308. <https://doi.org/10.1038/s41591-022-02012-w>

Sankar, P. L. & Parker, L. S. (2017). The Precision Medicine Initiative's All of Us Research Program: an agenda for research on its ethical, legal, and social issues. *Genetics in Medicine*, 19, 743-750. <https://doi.org/10.1038/gim.2016.183>

Sugie, N.F. (2018). Utilizing smartphones to study disadvantaged and hard-to-reach groups. *Sociological Methods & Research*, 47, 458-491. <https://doi.org/10.1177/0049124115626176>

Torous, J., Kiang, M.V., Lorme, J., & Onnela, J. (2016). New tools for new research in psychiatry: A scalable and customizable platform to empower data driven smartphone research. *JMIR Mental Health*, 3(2):e16. <https://doi.org/10.2196/mental.5165>