

## Research Summary

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Shyamal Peddada is a Senior Investigator who leads the Constrained Statistical Inference Group within the Biostatistics and Computational Biology Branch. The group focuses on developing broadly applicable rigorous biostatistical methods that are inspired by biomedical research. Methods developed by Peddada's group have applications to toxicology, epidemiology, various 'omics data and others. In addition to methodological research, the group is engaged in various scientific collaborations in biomedical research. A major area of research interest is to understand the role of human microbiome in health and disease.

Constraints arise naturally in many scientific investigations either due to the underlying study design and scientific hypotheses of interest, such as in a dose response study or in a time course experiment; or due to the intrinsic characteristics of variables under investigation, such as the expression of a gene participating in a cell-division cycle or in the circadian clock; or due to the underlying technology, such as the sc RNA-seq, 16S or metagenomics microbiome data, and others. Statistical methods that exploit such constraints are substantially more powerful than routine unconstrained statistical methods such as the standard linear regression, ANOVA, logistic regression or standard non-parametric methods. Equivalently, the constrained statistical inference-based methods require substantially smaller sample size for the same power than the standard methods. Hence, they potentially require fewer biospecimens and are cost effective. More importantly, in many instances these constrained inference-based methods provide better scientific interpretation of the data than the standard methods.

Peddada's group develops, parametric and non-parametric constrained inference-based methods in low as well as high dimensions and applies the resulting methodologies to a wide range of biomedical research projects. Some examples include gene expression studies in toxicology, microbiome studies related to infant gut, infectious diseases, chemical exposures, and others.

Several user-friendly and freely-downloadable software have been developed by Peddada's group such as [ANCOM](#), [ANCOM-BC](#), [ANCOM-BC2](#), [SECOM](#), [ORIOGEN](#), [CLME](#), [ORIOS](#), and [others](#).

In addition to conducting methodological and collaborative research, as well as developing user-friendly software, Peddada is actively engaged in mentoring trainees at all levels. His trainees are enjoying successful careers at various universities, research institutions and industries.

Prior to joining BCBB, Dr. Peddada was a Senior Investigator and the Chief of Biostatistics and Bioinformatics Branch at NICHD/NIH (2020 – 2022), the Chair of the Department of Biostatistics (2017 – 2020). He was also a member of BCBB (2000 – 2017) and acting Chief of BCBB (2016 – 2017). Dr. Peddada is a Fellow of the American Statistical Association (ASA), an elected Member of the International Statistical Institute, and a recipient of numerous awards including the ASA's Outstanding Statistical Applications Award.

## Selected Publications

1. Lin, H., Eggesbø, M., **Peddada, SD** (2022). Linear and nonlinear correlation estimators unveil undescribed taxa interactions in microbiome data. *Nat Commun* **13**, 4946. <https://doi.org/10.1038/s41467-022-32243-x>
2. Chen Y, Lin H, Cole M, Morris A, Martinson J, McKay H, Mimiaga M, Margolick J, Fitch A, Methe B, Srinivas VR, **Peddada S**, Rinaldo CR (2021). Signature changes in gut microbiome are associated with increased susceptibility to HIV-1 infection in MSM. *Microbiome*. doi: 10.1186/s40168-021-01168-w.
3. Lin H., **Peddada SD** (2020). Analysis of compositions of microbiomes with bias correction. *Nat Commun*. 11(1):3514. doi:10.1038/s41467-020-17041-7.
4. Rueda C., Larriba Y., **Peddada SD** (2019). Frequency Modulated Möbius Model Accurately Predicts Rhythmic Signals in Biological and Physical Sciences. *Sci Rep*. doi: 10.1038/s41598-019-54569-1.
5. Jelsema C, Kwok R, **Peddada SD** (2019). Threshold knot selection for large-scale spatial models with applications to the Deepwater Horizon disaster. *J. Statist. Comp. Simulation*. [//doi.org/10.1080/00949655.2019.1610884](https://doi.org/10.1080/00949655.2019.1610884)
6. Shockley KR, Gupta S, Harris SF, Lahiri SN, **Peddada SD** (2019). Quality Control of Quantitative High Throughput Screening Data. *Front Genet*. doi: 10.3389/fgene.2019.00387.
7. Davidov O, Jelsema CM, **Peddada SD** (2018). Testing for Inequality Constraints in Singular Models by Trimming or Winsorizing the Variance Matrix. *J. Amer. Statist. Assoc.* DOI: 10.1080/01621459.2017.1301258

8. **Peddada SD** (2017). Seasonal change in the gut: The gut microbiome of Hadza hunter-gatherers changes with the season. *Science* 357 (6353), 754-755. [Invited Perspective]
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10. Mandal M, Godfrey K, McDonald D, van Treuren W, Bjørnholt JV, Midvedt T, Moen B, Rudi K, Knight R, **Peddada SD**, Eggesbø M (2016). Fat and vitamin intakes during pregnancy have stronger relations with a proinflammatory maternal microbiota than does carbohydrate intake. *Microbiome* 4(1):55 DOI: 10.1186/s40168016-0200-3.
11. Mandal S, Van Treuren W, White RA, Eggesbø M, Knight R, **Peddada SD** (2015). Analysis of composition of microbiomes: a novel method for studying microbial composition. *Microbial Ecology in Health and Disease* 26, 1 – 7.
12. Davidov O, **Peddada SD** (2013). The linear stochastic order and directed inference for multivariate ordered distributions. *Annals of Statistics*, **41**, 1-40.
13. **Peddada SD**, Laughlin SK, Miner K, Guyon JP, Haneke K, Vahdat HL, Semelka RC, Kowalik A, Armao D, Davis B, Baird DD (2008). Growth of uterine leiomyomata among premenopausal black and white women. *Proc Natl Acad Sci U S A*. doi: 10.1073/pnas.0808188105.
14. **Peddada SD**, Lobenhofer EK, Li L, Afshari CA, Weinberg CR, Umbach DM (2003). Gene selection and clustering for time-course and dose-response microarray experiments using order-restricted inference. *Bioinformatics*. 19(7):834-41.
15. Hwang JTG, **Peddada SD** (1994). Confidence Interval Estimation Subject to Order Restrictions. *Annals of Statistics*, **22**, 67-93.

**Complete List of Published Work in MyBibliography:**

<https://pubmed.ncbi.nlm.nih.gov/?term=Peddada+S&sort=jour>