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PRIMER v7 and PERMANOVA+ WORKSHOPS
Honolulu, Hawaii, USA
Multivariate Analysis in Ecology (& other Sciences)

Presenters: Dr. Adam N. H. Smith *and* Distinguished Prof. Marti J. Anderson
Venue: NOAA Inouye Regional Center (IRC), Honolulu, Hawaii, USA
Dates: Week 1: November 26th-30th, 2018 – PRIMER v7 (Adam N. H. Smith)
Week 2: December 3rd-7th, 2018 – PERMANOVA+ (Marti J. Anderson)

The workshops run over two weeks (5 days per week, Monday – Friday, 09:00 to 18:00 each day). Participants may register for **week 1 only**, **week 2 only**, or **both weeks**. Each week mixes lectures and computer lab sessions on literature data sets and ends with a day in which participants can discuss and analyze their own data sets in consultation with the lecturer. **Participants are expected to bring their own laptop**. Software may be purchased (at a discounted price – see below) or a free fully functional but time-limited version can be made available to registered participants for trial use during the workshop. Note that PRIMER is a Windows-only product, so Macs need to run in Windows emulation.

Week 1

- The first week will provide an intensive and extensive overview of statistical methods in non-parametric analysis of multivariate data, encapsulated in the software: **PRIMER version 7**. The first week will cater to both those who are **new to PRIMER** and to those who are "**old hands**" but have not yet had a chance to learn about version 7. Important new tools include: **shade plots** with flexible ordering & clustering of axes; **coherence plots** to show species displaying statistically distinguishable response patterns; **unconstrained** binary or divisive **flat clustering** (as in *k*-means) along with **SIMPROF** tests; **metric**, **threshold metric**, **non-metric** or **combined MDS** in any dimensions; **bootstrap averages** to show variation among averages in metric MDS space; **2-way versions** of BEST and RELATE; **new plot types** (bar, box, means, line, histogram, scatter, surface, shade) in 2-d or 3-d; **animations** of ordinations captured to video files; multi-factor and multi-variable **segmented bubble plots** in 2-d and 3-d; ANOSIM extended for **ordered factors** and **3-factor** designs and much more...

- As well as covering the new methods in PRIMER 7, basic multivariate routines will be fully discussed, e.g. pre-treatment of data; definitions of similarity; clustering; ordination by principal components (**PCA**), non-metric (and metric) multi-dimensional scaling (**MDS**); permutation tests on similarity matrices for structured (**ANOSIM**, **RELATE**) and unstructured (**SIMPROF**) cases; emphasis on species analyses; linking community to abiotic data (**BEST**); biodiversity indices; means plots (with approximate region estimates), and the many graphical tools available for effective presentation of results. Non-parametric statistics and permutation tests make the methods intuitively simple to understand, so **no prior background in statistics is assumed**.

Week 2

- The second week will focus on **PERMANOVA+**, an add-on package to PRIMER v7. PERMANOVA+ extends PRIMER to allow analysis of multivariate data in response to complex designs, using semi-parametric partitioning on the basis of a resemblance measure of choice and with rigorous inferences *via* permutation methods. PERMANOVA+ allows more formal models, tests and predictions for multivariate (or univariate) ecological (and other) systems that are over-parameterised (i.e., have too many variables) or that demonstrate substantial non-normality. Participants should have some prior knowledge or experience of basic multivariate methods (such as that covered in week 1), and some prior exposure to complex experimental/sampling designs from a practical perspective is also desirable (but not essential) for week 2.

- Participants will explore: analysis and estimation of components of variation in complex experimental designs, including interactions, covariates, contrasts, fixed or random effects, crossed or nested models, unbalanced designs, environmental impact designs, randomized blocks or repeated measures (**PERMANOVA**); tests for homogeneity of multivariate dispersions and analyses of beta diversity (**PERMDISP**); multivariate regression and model selection procedures (**DISTLM**); principal coordinate analysis (**PCO**); distance-based redundancy analysis (**dbRDA**); canonical analysis of principal coordinates (**CAP**), including leave-one-out allocation success for discriminant analysis or canonical correlation analyses based on resemblance matrices and the placement of new points into existing predictive canonical models.

Venue

The workshops will be hosted by NOAA Papahānaumokuākea Marine National Monument (PMNM), and will be held at the NOAA Inouye Regional Center (IRC), Classroom 1377, 1845 Wasp Blvd, Honolulu, Hawaii 96818, USA. For further local information, including directions, access to the venue, parking, and other nearby options for accommodation, please consult the additional document "Local_info_IRC.pdf" and/or contact one of the local workshop co-organizers directly. The local co-organizers are Dr Atsuko Fukunaga (Joint Institute for Marine and Atmospheric Research (JIMAR)) atsuko.fukunaga@noaa.gov Tel: +1 808-725-5808 and LTJG Terril Efird (NOAA Corps/PMNM) terril.efird@noaa.gov Tel: +1 808-725-5834. Please note that it is each participant's responsibility to arrange and pay for their own accommodation - this is not included within the workshop registration fee.

Important! Please note that the workshop venue is located at the NOAA facility (IRC) on Ford Island. Security and access to Ford Island is maintained by Joint Base Pearl Harbor Hickam (JBPHH). **Participants will need to obtain prior security clearances to access the workshop venue.** There are two passes required: one for Ford Island and one for the IRC. To allow sufficient time to gain clearance and access to the venue to attend the workshop, **all participants or those interested in registering for the workshop (with the exception of IRC employees), must contact the local organizers ASAP** and no later than:

- **August 15th, 2018** (Non-U.S. citizens/foreign nationals)
- **October 15th, 2018** (U.S. citizens/permanent residents).

Registration Costs (in United States dollars USD)

	For either Week 1 or Week 2:	*For both Weeks 1 & 2:*
EARLY BIRD* *Before October 15th, 2018*	USD $990 ($690 for full-time students)	USD $1,780 ($1,240 for full-time students)
After October 15th, 2018	USD $1,110 ($795 for full-time students)	USD $1,995 ($1,430 for full-time students)

The course fee **includes** all course materials, coffee/tea and snacks during breaks, free Wi-Fi, and (if needed) a temporary software licence key for the duration of the workshop, **but not** meals, accommodation or the separate (discounted) costs of purchasing software. All prices are in US dollars.

Contact and Registration

To express interest in attending, please send an email directly to the PRIMER-e office: primer@primer-e.com. You will be sent a **registration form** and a detailed **schedule**. To register, please fill out the **registration form** and return it directly to primer@primer-e.com to secure your place. Places are limited. **Registration and payment must be received by November 1st, 2018**. Late registrants will only be accepted if space permits.

Software – discount prices for workshop participants

Participants wishing to purchase PRIMER software at the discounted prices shown below[1] should indicate this on the registration form. All prices are in US dollars[2].

	New PRIMER 7 (USD)	Upgrade PRIMER 6 to PRIMER 7 (USD)	PERMANOVA+ add-on (USD)
Private sector	$800	$400	$400
Public sector	$600	$300	$300
Academic	$400	$200	$200
Full-time student	$200	$100	$100

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[1] The workshop discount applies only to purchases of 3 or fewer licences within a given sector and excludes any additional discounts. Discounts for multiple purchases (i.e., up to 40%, see www.primer-e.com for details) accrue in the usual way for 4 or more licences.
[2] New Zealand and Australian residents attending the workshop must pay Goods & Services Tax (GST) for any software purchases.

About the Lecturers

Dr. Adam N. H. Smith (Massey University, Albany, Auckland, New Zealand) is a highly sought-after ecological statistician who specialises in the application of modern statistical methods to ecology and management, including fisheries and marine reserve assessment. Adam obtained his PhD from Massey University and has a wealth of multi-disciplinary experience across multiple sectors. He lectures across a wide range of areas, including both univariate and multivariate statistics, data mining, quantitative ecology and biostatistics. He has been a key consultant to industry and government, having worked as an in-house statistician for the Department of Conservation (DoC) and the National Institute for Water and Atmospheric Sciences (NIWA) in New Zealand. Adam is an enthusiastic and engaging lecturer with a passion for natural environments and for teaching and learning.

Distinguished Professor Marti J. Anderson (Massey University and PRIMER-e, *FRSNZ*, Auckland, New Zealand) is an ecological statistician whose work spans several disciplines, from ecology to mathematical statistics. A Fellow of the Royal Society of New Zealand, she is a Distinguished Professor of Ecological Statistics in the New Zealand Institute for Advanced Study at Massey University and her core research is in community ecology, biodiversity, multivariate analysis, experimental design and resampling methods, with a special focus on developing novel statistical methods for ecology. Marti developed all of the methods in PERMANOVA+ and especially loves engaging in the dynamic interactions with students, academics and professionals that have become a trademark of the PRIMER international workshops, shedding new light on multivariate data.