



<b>Title:</b>	Environmental Statistics <b>APPROVED</b>	
<b>Long Title:</b>	Environmental Statistics	
<b>Module Code:</b>	STAT8014	
<b>Duration:</b>	1 Semester	
<b>Credits:</b>	5	
<b>NFQ Level:</b>	Advanced	
<b>Field of Study:</b>	Statistics	
<b>Valid From:</b>	Semester 1 - 2019/20 ( September 2019 )	
<b>Module Delivered in</b>	<a href="#">1 programme(s)</a>	
<b>Next Review Date:</b>	March 2023	
<b>Module Coordinator:</b>	David Goulding	
<b>Module Author:</b>	Catherine Palmer	
<b>Module Description:</b>	This module focuses on statistical techniques used to extract useful information from environmental data.	
<b>Learning Outcomes</b>		
<i>On successful completion of this module the learner will be able to:</i>		
LO1	Explore environmental data sets and develop suitable data analysis protocols.	
LO2	Recognise different experimental design models and analyse associated data sets to support environmental decisions.	
LO3	Implement regression procedures for data interpretation.	
LO4	Use statistical software to interpret, model and analyse environmental data and report the results.	
<b>Pre-requisite learning</b>		
<b>Module Recommendations</b>		
<i>This is prior learning (or a practical skill) that is strongly recommended before enrolment in this module. You may enrol in this module if you have not acquired the recommended learning but you will have considerable difficulty in passing (i.e. achieving the learning outcomes of) the module. While the prior learning is expressed as named MTU module(s) it also allows for learning (in another module or modules) which is equivalent to the learning specified in the named module(s).</i>		
13573	STAT6014	Intro Stats for Phys. Sc.
13575	STAT7009	Inferential Statistics
<b>Incompatible Modules</b>		
<i>These are modules which have learning outcomes that are too similar to the learning outcomes of this module. You may not earn additional credit for the same learning and therefore you may not enrol in this module if you have successfully completed any modules in the incompatible list.</i>		
No incompatible modules listed		
<b>Co-requisite Modules</b>		
No Co-requisite modules listed		
<b>Requirements</b>		
<i>This is prior learning (or a practical skill) that is mandatory before enrolment in this module is allowed. You may not enrol on this module if you have not acquired the learning specified in this section.</i>		
No requirements listed		

**Module Content & Assessment**

**Indicative Content**

**Data Analysis Protocol**

Consolidate prior knowledge of graphical and numerical descriptive statistics to perform exploratory data analysis for both categorical and continuous data. Outlier detection, missing values, assumption testing and transformation of variables. Model fitting, interpretation and diagnostics.

**ANOVA**

Fundamentals of analysis of variance (ANOVA), partition of sum of squares, mean squares, F ratios and post-hoc testing.

**Design of experiments**

Experimental (vs) Observational data. Fundamentals of experimental design. One-way and two-way ANOVA, randomised block design and full-factorial design.

**Regression**

Simple linear regression and an introduction to multiple linear regression. Assumptions, collinearity, interpreting coefficients, model fitting, model diagnostics.

**Laboratory Programme**

Use of statistical software in examining environmental statistical data including time series data decomposition (trends, periodicity seasonality), time series smoothing techniques, forecasting and interpreting heat maps.

**Assessment Breakdown**

	%
Course Work	40.00%
End of Module Formal Examination	60.00%

**Course Work**

Assessment Type	Assessment Description	Outcome addressed	% of total	Assessment Date
Short Answer Questions	In-class test: experimental design	1,2	15.0	Week 7
Project	Analyse an environmental data set and report the results	1,2,3,4	25.0	Week 10

**End of Module Formal Examination**

Assessment Type	Assessment Description	Outcome addressed	% of total	Assessment Date
Formal Exam	End of semester final examination	1,2,3,4	60.0	End-of-Semester

**Reassessment Requirement**

**Repeat examination**

Reassessment of this module will consist of a repeat examination. It is possible that there will also be a requirement to be reassessed in a coursework element.

The institute reserves the right to alter the nature and timings of assessment

**Module Workload**

<b>Workload: Full Time</b>				
<i>Workload Type</i>	<i>Workload Description</i>	<i>Hours</i>	<i>Frequency</i>	<i>Average Weekly Learner Workload</i>
Lecture	Module content delivery	2.0	Every Week	2.00
Lab	Analysis using statistical software	2.0	Every Week	2.00
Independent & Directed Learning (Non-contact)	Exercise Sheets	3.0	Every Week	3.00
Total Hours				7.00
Total Weekly Learner Workload				7.00
Total Weekly Contact Hours				4.00

**This module has no Part Time workload.**

## Module Resources

### Recommended Book Resources

- Montgomery, D.C. & Runger G.C 2014, *Applied Statistics and Probability for Engineers*, Wiley [ISBN: 978-1-118-744]

### Supplementary Book Resources

- Steven P. Millard 2013, *EnvStats - An R Package for Environmental Statistics*, Springer-Verlag New York [ISBN: 978-1-4614-84]
- Dennis Wackerly, William Mendenhall, Richard L. Scheaffer 2008, *Mathematical Statistics with Applications* [ISBN: 978-049511081]
- Matthias Otto 2016, *Chemometrics: Statistics and Computer Application in Analytical Chemistry*, Chapters 2 and 3, Wiley [ISBN: 9783527340972]
- Murray R Spiegel and Larry J Stephens 2017, *Schaum's Outline of Statistics*, McGraw-Hill [ISBN: 978-126001146]

### Recommended Article/Paper Resources

- Eurostat *Statistics Explained*  
<http://ec.europa.eu/eurostat/statistics-explained/index.php/Environment>

### Other Resources

- Website: *Package for Environmental Statistics, Including US EPA Guidance*  
<https://cran.r-project.org/web/packages/EnvStats/index.html>
- Ebook: Eurostat 2010, *Environmental statistics and accounts in Europe*  
<http://ec.europa.eu/eurostat/en/web/products-statistical-books/-/KS-32-10-283>
- Website: *EPA Air Quality Data*  
<http://www.epa.ie/air/quality/data/>
- Website: *US Air quality Data*  
<https://www.epa.gov/outdoor-air-quality-data>
- Website: *Fixed point Open Ocean Observatory network (FixO3) datasets*  
<http://earthvo.fixo3.eu/>
- Website: *Minitab blog posts for learning statistics*  
<http://blog.minitab.com/blog/landing-pages/minitab-blog-posts-for-learning-statistics>
- Website: *Wolfram Alpha*  
<http://www.wolframalpha.com/examples/math/statistics/>

**Module Delivered in**

Programme Code	Programme	Semester	Delivery
CR_SESST_8	<a href="#"><u>Bachelor of Science (Honours) in Environmental Science and Sustainable Technology</u></a>	7	Mandatory