

# MRC-PHE/ Exposomics Short Course

## Stat-XP

Statistical approaches to characterize the exposome from  
OMICs platforms

Overview and Perspectives



**Monday 8<sup>th</sup> to Friday 12<sup>th</sup> December, 2014,**  
**London, United Kingdom:**

Royal Statistical Society (Old Street) &  
Imperial College, St Mary's Campus (Paddington)

## COURSE OUTLINE

**STAT XP** is an introductory short course to statistical models required to analyse high throughput data from well-established OMICs platforms. This includes genetic, transcriptomic, metabonomics and epigenetics data.

The course will provide an in-depth description of the OMICs data, their features, and the challenges their statistical analysis raises.

Stat XP will also propose a series of lectures describing the main statistical methods used in molecular epidemiology. These include univariate models and multiple testing correction strategies (FWER, FDR), dimension reduction techniques, and variable selection approaches.

Corresponding seminars will show how these methods are used in practice, and computer-based practical sessions will give the students the opportunity to use and get familiar with the well-established software/packages enabling such analyses. Finally, we will describe methodological perspectives to improve the analysis of OMICs data in the context of the exposome.

## COURSE OBJECTIVES

**STAT XP** will enable research professionals to better understand the growing literature relying on the analysis of OMICs data. Participants will be able to run their own analyses at the end of the course (readily usable scripts from practicals will be provided). This should open doors to the implementation of novel studies building upon existing underexploited data or publicly available databases. Potentially interested audience ranges from academics with statistical/biological/clinical backgrounds, to non academics with interests in risk stratification.

## COURSE ACCREDITATION

**STAT XP** is integrated in the teaching activities of the MRC-PHE Centre for Environment and Health. It is also part of the dissemination activities of the statistical workpackage of the FP7 **EXPOSOMICS** project, co-lead by ICL and Utrecht University. The course is done in rotation the Molecular Epidemiology Course at Utrecht University. The first edition of the course was in 2013 in Utrecht, and the 2014 Stat-XP is the first Imperial edition.

## COURSE FORMAT

**STAT XP** is a 5-days short course taking place in London 8<sup>th</sup>-12<sup>th</sup> December, 2014. The course comprises 4 days teaching that articulated as follows: the day starts with lectures introducing the theoretical concepts. These are subsequently illustrated on the same day by a seminar and practical.

On Wednesday, 10<sup>th</sup> a full seminar day is planned to illustrate the practical use, validity, strength of the methods presented in the course.

## SPECIFIC LEARNING OUTCOMES

After **STAT-XP**, students will:

- Be familiar with the exposome concept
- Understand the main statistical issues raised by the molecular characterisation of the internal exposome
- Know what are the main OMICs data routinely available, what they measure, and what are their main features, and what statistical challenge they raise
- Know what are the main types of approaches available to analyse OMICs data
- Be able to independently implement, run and interpret such analyses using R software
- Be familiar with the main limitations and complementarity of the well-established methods
- Understand future direction of statistical research for exposome characterisation

## TARGET AUDIENCE

**STAT XP** will be of interest to academics (students, and researchers), and scientists from the industry (pharmaceutical companies, insurance companies, food industries...). No prior knowledge is required, but experience in basic statistics, and use of statistical software (preferably R) is desirable. Participants should bring their own laptops.

Up to **40 participants** can register

## REGISTRATION/FEEs

**REGISTRATION** can be done online:

[http://www5.imperial.ac.uk/medicine/coursebookings/statxp\\_2014.html](http://www5.imperial.ac.uk/medicine/coursebookings/statxp_2014.html)

For any question please send an email to:

[m.chadeau@imperial.ac.uk](mailto:m.chadeau@imperial.ac.uk)

Course fees:

- Academic: £1,200
- Non-academic: £1,800

## LOCATION

**TEACHING DAYS** will take place at the Royal Statistical Society (Old Street, London)

**THE FULL DAY SEMINAR** will take place at St Mary's Campus, Imperial College, London.

## CONTRIBUTORS

### IMPERIAL COLLEGE LONDON (UK):

**PROF PAUL ELLIOTT**, Professor of Epidemiology and Public Health Medicine, Head of Dept of Epidemiology and Biostatistics. Director of MRC-PHE Centre for Environment and Health.

**PROF PAOLO VINEIS**, Professor of Environmental Epidemiology. Dept of Epidemiology and Biostatistics. Adjunct Professor, Columbia University, NYC – USA.

**DR MARC CHADEAU-HYAM**, Lecturer in Statistical Bioinformatics, Dept of Epidemiology and Biostatistics. Honorary Reader, Utrecht University.

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### UTRECHT UNIVERSITY (NL):

**DR ROEL VERMEULEN**, Associate Professor, Institute for Risk Assessment Sciences. Honorary Professor, Imperial College London.

**DR JELLE VLAANDEREN**, Junior Assistant Professor, Institute for Risk Assessment Sciences

### UNIVERSITY OF QUEENSLAND (AUS):

**DR BENOÎT LIQUET**, Senior Lecturer in Statistics, School of Mathematics and Physics

### UNIVERSITY COLLEGE LONDON (UK):

**DR MARIA DE IORIO**, Reader in Statistics in the Dept of Statistical Science

### INTERNATIONAL AGENCY FOR RESEARCH ON CANCER (FR):

**DR AUGUSTIN SCALBERT**, Head of the Biomarkers Group

## PROGRAMME

### DAY 1

#### **MONDAY 08/12 - INTRODUCTION TO THE EXPOSOME CONCEPT, OMICS DATA:**

**9.15-09:45 WELCOME AND REGISTRATION**

**9.45-10:05 INTRODUCTION:** Overview of the course - Presentation of the speakers

Speaker: M Chadeau-Hyam

**10:15-11:00 LECTURE 1:** *'The exposome concept: origin and implementations'*

Speaker: R Vermeulen

**11:00-12:00 LECTURE 2:** *'OMICs data in practice: introduction to OMICs platforms'*

Speaker: G. Campanella

**12:00-13:15 LUNCH BREAK**

**13:15-14:00 SEMINAR:** *'Introduction to NMR metabolic profiling and data analysis'*

Speaker: T Ebbels

**14:00-14:45 SEMINAR:** *'Analysing the exposome by mass spectrometry – a Review'*

Speaker: A Scalbert

**15:00-17:30 PRACTICAL:** *'Introduction to R - Handling OMICs data in R'*

Tutor: J Vlaanderen/ R Castagné / G Campanella

### DAY 2

#### **TUESDAY 09/12 - STATISTICAL ANALYSES OF OMICS DATA:**

##### **UNIVARIATE AND MULTIVARIATE MODELS**

**09:30-11:00 LECTURE 1:** *'\*-WAS: univariate approaches – multiple testing correction strategies – modelling nuisance variation'*

Speaker: M Chadeau-Hyam

**11:15-12:45 LECTURE 2:** *'Introduction to multivariate approaches: dimension reduction and variable selection'*

Speaker: M Chadeau-Hyam

**12:45-14:00 LUNCH BREAK**

**14:00-17:00 PRACTICAL:** *'Performing \*WAS using R'*

Tutors: G Campanella; J Vlaanderen; R Castagné

DAY 3

**WEDNESDAY 10/12 - SEMINAR DAY (CLINICAL THEATRE ST MARY'S HOSPITAL)**

**MORNING SESSION: SYSTEMS BIOLOGY IN PRACTICE**

**09:30-10:15:** *'Exposome-Related Research in the MRC-PHE Centre for Env & Health'*

Speaker: P Elliott

**10:15-11:00:** *'The Benzene story'*

Speaker: R Vermeulen

**11:15-12:00:** *'Epigenetic markers of smoking'*

Speaker: F Guida

**12:00-12:45:** *'DNA-Methylation, Cause or Consequence?'*

Speaker: B Lehne

**12:45-14:00: LUNCH BREAK**

**AFTERNOON: CURRENT METHODOLOGICAL DEVELOPMENTS**

**14:00-14:45:** *'Differential networks in practice'*

Speaker: M De Iorio

**14:45-15:30:** *'Introduction to network theory'*

Speaker: G Campanella

**15:45-16:15:** *'Thinking big - building a statistical toolbox for big data analysis'*

Speaker: K Strimmer

**16:15-17:00:** *'Exposome and socio-molecular epidemiology'*

Speaker: P Vineis

DAY 4

**THURSDAY 11/12/2014 – PATHWAY ANALYSES, DIMENSION REDUCTION EXAMPLES**

**09:30-10:30 LECTURE 1:** *'Introduction to pathway analyses'*

Speaker: R Castagné

**11:00-12:00 LECTURE 2:** *'A tutorial for penalized regression models'*

Speaker: B. Lique

**12:00-13:00 LUNCH BREAK**

**13:00-14:00 LECTURE 3:** *'A tutorial for sparse PLS models'*

Speaker: B. Lique

**14:00-17:00 PRACTICAL:** *'Using variable selection in R'*

Tutors: J Vlaanderen/ B Lique

DAY 5

**FRIDAY 12/12/2014 – WRAP-UP/PERSPECTIVES**

**09:00-13:00 PRACTICAL:** *'Real case analysis of omics data'*

Tutors: G Campanella, J Vlaanderen, R Castagné

**13:00-14:00 LUNCH BREAK**

**14:00-14:45 SEMINAR:** *'Emerging data and question in the exposome field'*

Speaker: R Vermeulen

**14:45-15:30 SEMINAR:** *'From exposome to Mechanome'*

Speaker: M Chadeau-Hyam

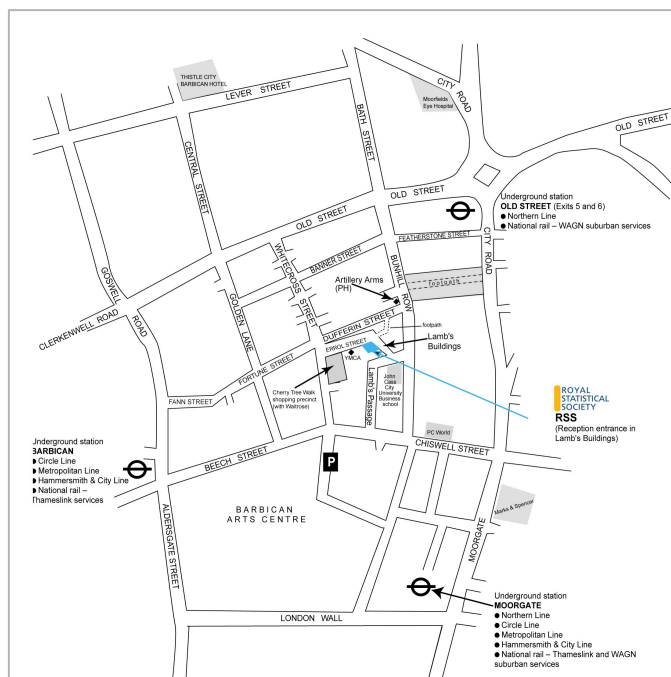
**15:45 -16:30 WRAP-UP SESSION: Q & A**

## MAPS/DIRECTIONS

### ROYAL STATISTICAL SOCIETY

**VENUE: CHAMBERS ROOM**

**CLOSEST TUBE STATIONS: OLD STREET / BARBICAN / MOORGATE**



### IMPERIAL COLLEGE LONDON (ST MARY'S)

**VENUE: CLINICAL LECTURE THEATRE (2<sup>ND</sup> FLOOR, CAMBRIDGE WING, SEE MAP)**

**CLOSEST TUBE STATIONS: PADDINGTON / EDGWARE ROAD**

