Statistics teaching within UK degree programmes in Medicine and allied health sciences, including through undergraduate and postgraduate entry schemes and intercalation

Note. This particular form is not for inclusion of details of statistical teaching in Masters and PhD programmes.

Institution: University of Edinburgh

Overview: A considerable amount of undergraduate medical student learning in statistics takes place within the context of research project work under the Year 5 Student Selected Component (SSC5a) programme, the statistical input for which is led by myself (Margaret MacDougall) and in some cases, intercalated honours degree programmes (see further details later in form). This learning is non-mandatory, however, in the sense that students learn statistics according to the needs of their self-selected projects. These projects vary considerably in terms of required skills and knowledge. Students are supported in their statistical learning by myself through one-to-one consultations and via the complementary website StatsforMedics (see below).

As from the academic year 2018-2019, Year 2 students have also attended a 6-week course entitled 'Data Science in Medicine'. The Medical Informatics and Statistics lectures (Lectures 1-9) are delivered as short online videos that the students can watch at their own pace, while the Epidemiology lectures (Lectures 10-14) take place in a lecture theatre. Lectures 1 - 9 include 3 lectures in statistics which cover introductory statistics (*data scales*, *summary statistics* and *population and samples*), visualizing data (including coverage of very basic charts, such as when to use a simple barchart, cluster barchart, simple pie-chart, histogram, boxplot for one group, a simple scatterplot or line graph) and a very basic introduction to hypothesis testing, inclusive of the topics *correlation: basic concepts, visualization and correlation coefficient*, *key concepts in hypothesis testing*, *correlation coefficient as a statistical test*, *the chi-square test for categorical data* and the theory behind the one-sample and independent samples t-test. The lectures are complemented with 11 brief videos. In addition, there is a single lab and two tutorial sessions (class sizes: ~ 15) providing a basic introduction to the use of R and R studio to apply ideas from the above lectures. This part of the course is managed by Areti Mantaki and is not formally assessed by means of a summative assessment. The remaining part of the course (led by Igor Rudan) covers public health-oriented teaching on study design, critical appraisal, diagnostic statistics and concepts of epidemiology. There is no formal (summative) assessment of statistics for Data Science in Medicine.

To take students further forward with statistics, particularly in relation to the nuances of real clinical research data, I have developed the Open Access WordPress site StatsforMedics (https://medstats.mvm.ed.ac.uk). The content is largely informed by queries raised by senior undergraduate medical students during one-to-one appointments over a 15-year period and as such, covers a more comprehensive list of topics in statistics and probability than those specified by the checkboxes below. As indicated on the page SCOPE AND USE OF SITE, 'I have designed and presented the content within these pages specifically for use by undergraduate medical students who are considering use of statistics for short-term research projects. However, this is with the

understanding that students from allied health sciences may also benefit from engaging with the site and its sister site, Statistics CALs.'

Type of undergraduate students:

Medical ☒   Dental ☐   Biology ☐

Mathematics ☐   Other ☐ (please state:)

Estimated total number of students:

Years 2 - 5: ~ 270

Year 3: Since the academic year 2016 – 2017, completion of an intercalated honours year, usually comprising the honours year of any one of approximately 20 available biomedical science degree programmes, is mandatory, except for those students, typically graduate entry students, who have completed an equivalent year of study. Depending on choice of honours degree, students undertake bespoke learning in statistics through using a statistical package, such as GraphPad Prism, R or SPSS, occasionally involving a short computer-based course covering statistical hypothesis testing, up to the level of Analysis of Variance (ANOVA).

In 2018, a new one-year intercalated honours year programme, leading to a BMedSci, was launched, with 33 and 38 MBChB enrolled for 2018 - 2019 and 2019 -2020, respectively. This course includes the modules Research Skills in Health Sciences (RSHS), which includes 9.5 hours of statistics teaching covering:

1)
- Project planning (major emphasis) and the appointments system

- Online resources: WordPress site StatsforMedics

- Questionnaire design and recording data from patient notes

- Arranging data in spreadsheets for statistical analysis

- Hypothesis testing (flowcharts provided) and Normality testing

- Use of charts in reports

- Advice from previous students

2) An overview of additional key topics in statistics and probability, including:

• A range of techniques for graphical presentation of data in Excel and SPSS and the contexts where their use may enhance report writing;

• choosing the right summary statistics based on the type and distribution of data;

• Statistical significance, statistical power and some facts about p-values;

• The chi-square test of association versus Fisher's Exact test;

• Odds ratios and their confidence intervals;

• Presenting the findings and conclusions of statistical hypothesis tests;

and

• Getting more out of the Mann-Whitney U-test as a test for non-parametric data.

3) Linking theory to practice through use of SPSS

The above teaching involves is delivered by myself and includes a combination of whole-class lecturing, small group tutorials enabling students to engage with worked examples and exercises in preparation for the written examination, and whole class lab work using SPSS.

In addition to the 9.5 hours of teaching outlined above (which takes place in semester 1), I provide a 2-hour exam revision session in semester involving small group work. I also complement the teaching in semester 1 with formative assessment, a prior-learning in statistics quiz, written assessment and assessment of preparation and analysis of data in SPSS.

An additional 3-hour session is delivered by the Edinburgh Clinical trials Unit (ECTU). This session is primarily aimed at equipping better critical assessment of clinical trials but leads into an outline of what is involved in setting up a clinical trial (design, approval process, monitoring and regulation, trial registries. The session is managed by the director of the ECTU (Professor John Norrie).

Students also gain exposure to statistical topics, such as diagnostic statistics, study design, risk of bias, conduct of RCTs and big data, through those aspects of the RSHS course which are delivered by non-statisticians and have a more clinical orientation.

The RSHS summative assessment is a 2.5-hour written assessment, 20% of which covers statistics.

Years 4 and 5 - introductory lectures for SSC5a students on project planning, research design and statistics. These lectures are of length 50 minutes and 1.5 hours, respectively and include:

-        Topical examples on the need for a) assumptions testing prior to choice and

-        Application of statistical procedures and b) avoiding misconceptions through

- Awareness of the phenomenon regression to the mean;

- Pointers to online tutorials in statistics covering use of the statistical package

- SPSS, types of data (as a prelude to hypothesis testing), and fundamentals of:

Hypothesis testing, questionnaire design, ANOVA and sample size calculations.

Class structure
Year 4 – whole class teaching

Year 5 (Year 5 Student Selected Component (SSC5a)): 270 – split into cohorts of size ~90. Students allocated to 14-week blocks for their research projects. Students gain experience in the interpretation and application of statistics as part of their project work. They are advised to plan early with a view to getting started before the official start dates of their projects.

Please add fields to the table below, where necessary, to reflect missing subjects. This can easily be achieved by right-clicking in the last row and choosing the option 'insert' to insert individual rows. You can in turn copy-paste the content from an existing row and edit the subject name to suit your purposes.

All of what is listed below and very much more than can be listed here are, which are mainly accessed by Year 4 students but are also occasionally accessed by honours sciences students and students in any year who are involved in extra-curricular projects. The exception to this is that while I encourage students to understand some of the key concepts associated with meta-analysis and multivariate analysis, I discourage them from applying the associated methodologies, given their time constraints and lack of competence and prior learning.

Subject	Concept	Calculations/equations*	Descriptions/comments
Types of variable	☒	☒	Covered in StatsforMedics and one-to-one project-focused sessions
Distributions	☒	☒	Covered in StatsforMedics and one-to-one project-focused sessions
Summary Statistics	☒	☒	Covered in StatsforMedics and

			one-to-one project-focused sessions
Concepts of population and sample	☒	☒	Covered in StatsforMedics and one-to-one project-focused sessions
Confidence intervals	☒	☒	Covered in StatsforMedics and one-to-one project-focused sessions
Hypothesis testing, p-values	☒	☒	Covered in StatsforMedics and one-to-one project-focused sessions
Comparing two means	☒	☒	Covered in StatsforMedics and one-to-one project-focused sessions
Comparing two proportions	☒	☒	Covered in StatsforMedics and one-to-one project-focused sessions
Linear regression	☒	☒	Covered in StatsforMedics and one-to-one project-focused sessions
Logistic regression	☒	☐	Covered in StatsforMedics and one-to-one project-focused sessions
Graphs	☒	☒	Covered in StatsforMedics and one-to-one project-focused sessions

Survival analysis	☒	☒	Covered in StatsforMedics and one-to-one project-focused sessions
Multivariate analysis	☒	☒	Covered in StatsforMedics and one-to-one project-focused sessions
Critical appraisal	☒	☒	Covered in StatsforMedics and one-to-one project-focused sessions
Meta-analysis	☒	☒	Theory covered in StatsforMedics; practice covered in special cases within one-to project focused sessions for students of Years 3 and 5

*If applicable.

Assessment details:

Intercalated honours students and SSC5a students have their dissertation work assessed. Assessment of statistics in other parts of the intercalated honours courses is likely to vary greatly according to choice of course. Further assessment details are provided in previous sections of this form.

Computer package used:

Stata ☐   SPSS ☒   StatsDirect ☐   S-plus ☐   R ☒   (with R in Year 2, script already provided for students to run very basic procedures; students are not encouraged to routinely use R, but may do so for projects in later years based on suggestions from clinical supervisors)

NCSS ☐   Matlab ☐   Other ☒, please state which: Minitab, GraphPad Prism – GraphPad Prism is not supported by the University of Edinburgh Information Services division. However, research supervisors frequently advise their students to use this package

within the context of biological science dissertation projects during intercalated honours years.

Recommended literature: (in Year 5) – via the pages *Useful Textbooks: Paper Copies* and *Textbooks: Electronic Copies*, students are provided with access to comprehensive content on StatsforMedics covering a much wider range of textbooks than those listed below. However, the first three items listed below are recommended to students during the introductory session in Year 5, where students are provided with the opportunity to view hard copies. The Kindle version of item 2) is also recommended at this stage.

1) Medical Statistics at a Glance by Aviva Petrie and Caroline Sabin

2) SPSS Survival Manual: A step by step guide to data analysis using SPSS by Julie Pallant

3) SPSS Step by Step Essentials for Social and Political Science by Cole Davis

4) How to Report Statistics in Medicine by Thomas A Lang [This particular reference, which is provided electronically by the University library is recommended on StatsforMedics, along with other resources, on the page Presenting the Findings and Conclusions of Statistical Hypothesis Tests.]

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Contact - tutors

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Other comments: None

Information last up to date: 26/08/2019

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