

**APPROACHES TO EXTRA-CURRICULAR STATISTICS SUPPORT
FOR NON-STATISTICS UG AND PG:
FACILITATING THE TRANSITION TO HIGHER EDUCATION**

Chetna Patel, Brigitte Garcia De Jager and Lu Zou
Learning and Teaching Services, University of Sheffield, United Kingdom
chetna.patel@shef.ac.uk

To address the growing diversity of ability and skills of the student intake the University of Sheffield has set up the Maths and Statistics Help Centre to provide extra-curricular support to help students make the transition to Higher Education. The provision of maths support has been around since the early 90's and has developed into a sophisticated and valued means of addressing mathematical diversity. In contrast statistics support is new in its development and is being seen as a subject in its own right rather than as part of mathematics. This paper will provide the university's attempt at enhancing statistics support. First it will review current provision of statistics support and consider feedback received, secondly it will draw up a plan for developing the support to better fit the need. Another element of this study is to examine how the effectiveness of statistics provision can be measured.

BACKGROUND TO STATISTICS SUPPORT

There is evidence that students' mathematical and statistical ability affects progress on programmes of study that have a numerate element (Lawson, Croft & Halpin, 2003). In addition to the expected varying ability in mathematics and statistics this situation has been further exasperated with recent recruitment demands placed on universities in the UK (Clark, 2003), which has led to a wider range of qualifications that are acceptable for entry to university. This wider range of entry qualifications and ability has led to a need for transitional support for many students entering university; this paper describes one institutes attempt at addressing the issue and in particular the statistics support element.

Extra-curricular mathematics and statistics support services in the UK have been set-up since the early 1990's (Beveridge & Bhanot, 1994) to help students gain a reasonable understanding of mathematics and statistics without which progression on their main programme of study becomes difficult and in some cases leading to dropping out. Currently more than 60% of the UK's Higher Education Institutes (HEI) provide some form of support (Beveridge, 1997; Perkin & Croft, 2004) in addition to the mathematics and statistics taught within the students' chosen programme of study. The type of support varies from institutes to institute and comes in the form of: bridging courses, learning resource (paper and electronic), diagnostic testing and follow-up, drop-in centres, workshops, one-to-one support and peer assisted study support (Samuels & Patel, 2009). Mathematics Support centres are not only limited to the UK but are now present world-wide. MacGillivray (2008) reports that 32 universities in Australia have some form of mathematics learning support. Gill, O'Donoghue and Johnson (2008) reports there were 13 tertiary mathematics support centres in the Republic of Ireland.

Majority of the support methods employed have been used within the mathematics support context, the same methods have not translated easily into statistics support as experienced at the Maths and Statistics Help Centre (MASH) at the University of Sheffield (UoS). The requests for statistics help is usually related to carrying out an analysis and therefore the 1 or 2 sessions which work well for maths help does not seem to suffice in statistics help. The authors conclude this may be because the stages in the life-cycle of carrying out an analysis for a project are not easily dealt with as standalone skills and if enough statistics is not taught within the student's main programme, statistics support becomes their main source of information for carrying out their analysis, it would be good to be able to say main source of understanding the analysis process but time does not allow for this.

The situation is not unique to UoS and other universities have also sought to provide effective statistics help (Smith & Gadsden, 2006). There are a number of universities in the UK that now provide some form of statistics support through statistics advisory centres and services,

this is *not* be mistaken for the consultancy services (at a charge) often provided by Universities internally and externally.

STATISTICS SUPPORT AT THE UNIVERSITY OF SHEFFIELD

The development of statistics support within MASH at UoS has recently been given a higher profile to raise its effectiveness in helping students make the transition to HE studies and to become as efficient as possible especially in this current economic crisis. The maths support attracts good usage numbers and feedback, the statistics support numbers have been increasing but there is still concern that using the same methods as used for maths support is not ideal. Table 1 and figure 1 show the number of visits for maths and statistics help, in figure 1 the low numbers for the Arts Faculty (only 9 visits in total) have been omitted to allow for a better visual for the other faculties.

Table 1. Maths and Statistics Overall Usage Numbers

Faculty	Maths	Statistics
Arts	1	8
Engineering	1160	32
Medicine	4	93
Pure Science	184	68
Social Sciences	169	184

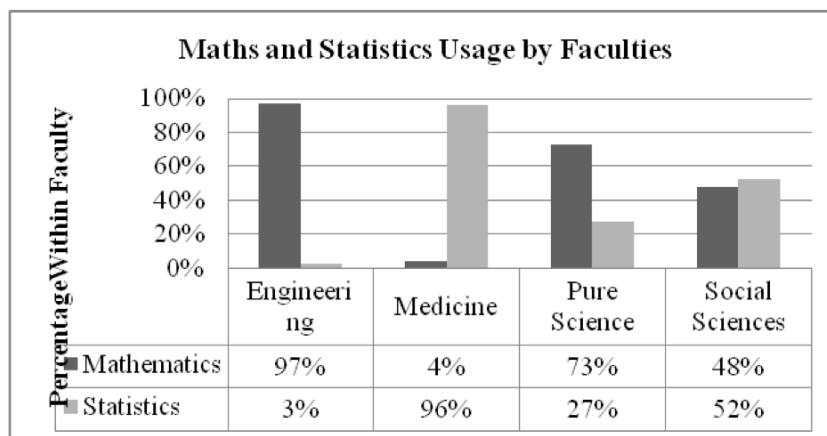


Figure 1. Usage of Math and Stats support by faculties

MASH statistics tutors are statistics PhD researchers (employed on an Ad Hoc basis) who have been given guidance on level of support to provide i.e. advice on project work is restricted to highlighting appropriate methods for specific needs ensuring the responsibility remains with the student in terms of making choices on methods. Students are expected to have a general understanding of the statistics they want to use, or at least to come with some suggestions from their supervisors or lecturers. We offer help if they have difficulties understanding the methods or using the software.

Since the creation of MASH, overall demand for statistics support has been growing (see table 2) and as stated earlier UoS is examining how best to provide statistics support. It is good to see that the usage at the beginning of the autumn semester (October and November) and the spring semester (January and February) is higher than at other times as we pro-actively encourage students to make use of the services earlier on in the semester before gaps and misunderstandings become a problem. The high numbers in April are likely to be related to project hand-in dates in May and the usage figures during August are for students needing to revise for resit examinations.

Table 2. Attendance for statistics support by month in 2007-2009

AcademicYr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug
2007/08	7	11	8	8	1	6	18	4	5	Closed	17
2008/09	25	22	20	16	32	19	19	6	4	Closed	21
2009/10	42	39	12	20							

Statistics support needs different methods than those used for maths support in that, firstly, the level of maths and statistics support requirements differs from discipline to discipline and hence the variation of usage between Faculties is expected. Maths support is highly sought by undergraduates in Engineering and Pure Science departments, while statistics support is highly demanded by the more social and humanities departments, e.g., Social Sciences departments. From figure 1 we can see that students in the Social Sciences department have made use of both maths and statistics support, geography and economics are in the Faculty of Social Sciences and have a strong numerate *and* statistics element and make up high number of support users in both areas.

Second, maths support can be broken down into smaller stages or processes and skills, e.g., learning to differentiate and its uses does not necessarily depend on being able to use partial fractions, though this does become necessary eventually when the student wants to calculate more complicated derivatives, but this can be done in stages as the need arises. However, statistics support is required mainly around project work where there is a focus on analysis. Table 3 gives a breakdown of the type of statistics support requested by year of study and we can see that the basic skills are requested mainly by first years who will be studying statistics as a subject then in later years especially third and plus, the requests are related to project analysis.

Table 3. Statistics Topics by Year of Study

Study Year/ Topics	Foundation & Year 1	Year 2	Year 3	Year 4 & Plus	Total	Percentage of Total
Descriptive	9	3	3	1	16	4.41%
Probability	9	7	0	3	19	5.23%
Project Statistics	0	0	20	2	22	6.06%
Analysis	1	4	3	9	17	4.68%
Regression	7	0	3	1	11	3.03%
Statistical Tests	5	6	9	4	24	6.61%
Use of Packages	9	5	15	8	37	10.19%
Statistics	78	53	58	20	209	57.58%
Other	1	2	1	3	7	1.93%
Unknown	1	0	0	0	1	0.28%
	120	80	112	51	363	

The statistics support covers various topics, which have been gathered from the feedback collected from students, to make for easier interpretation the topics have been summarised into the following categories:

- **Descriptive:** data summary, mean, median, standard deviation, correlation, confidence intervals
- **Probability:** probability calculation, distributions, maximum likelihood estimation, conditional probability
- **Project Statistics:** students need help on their projects
- **Analysis:** Meta-analysis, Factor analysis, time series
- **Statistical Tests:** hypothesis tests, t test, Chi-square test, ANOVA, Z-test
- **Regression:** general linear regression, logistic regression, multilevel modelling
- **Use of Packages:** SPSS, SPlus, Excel, Minitab
- **Statistics:** unspecified topics
- **Others:** graphs, sample size, risk management, etc.
- **Unknown:** Not specified.

According to the MASH tutors' experience, statistics help is generally required by the students working on projects or assignments requiring analysis and the help required differs every time; different projects require different analysis methods; sometimes, even though the methods may be the same, the applications vary. Support and advice may be required at any point through the project therefore even the categories; Analysis, Regression, Statistical Test and Use of Packages may be related to project work as well. With this in mind figure 2 make it clear that project analysis of data is the highest area of support request especially for later years of study.

It's found that in the third year, there's an increasing demand of support on projects and package using, as well as the support specific on statistic tests. In year 1 and 2, help on Probability and Descriptive Analysis is often required. It can be noticed that research students need support on specific topics, such as Time series, Meta-analysis, Factor analysis which have a strong analytical element.

In figure 2 the Arts faculty has been excluded because of very low numbers be it can be seen the remaining faculties all have a need for support in project work, probability and descriptive use of data. All have a similar pattern of usage except Social Sciences who have a High need for learning to use descriptive data and this is mainly by year 1s (see figure 3).

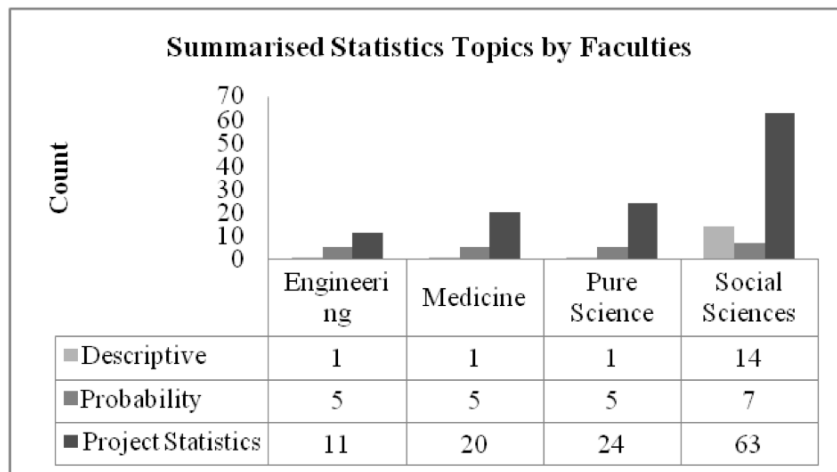


Figure 2. Summarised Statistics Categories by Faculties

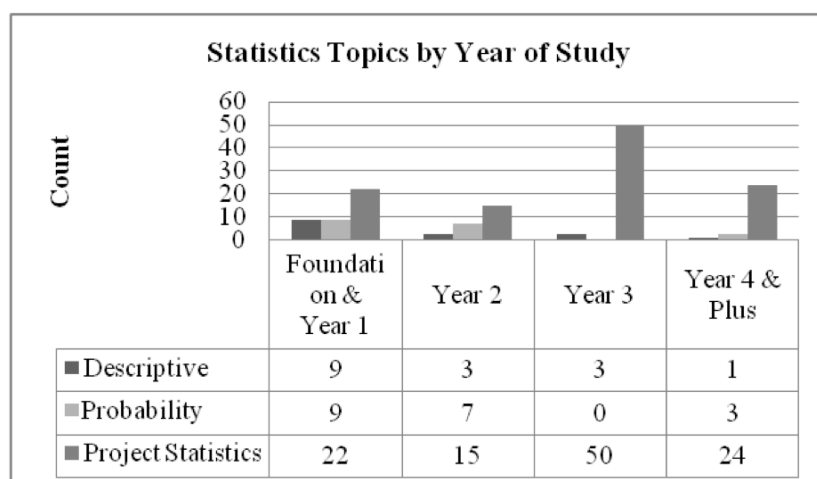


Figure 3. Summarised Usage of Statistics Support by Year of Study

Table 4 displays the distribution of mathematics and statistics support usage by different years of study by faculties. From the total usage, we can see that maths support is mainly needed by year 1-3 students. Relatively, statistics support has high usage figures for year 1 and years 3 and

above, implying that research students have higher demand of statistics help than mathematics help.

Table 4. Mathematics and Statistics Support Usage: Faculty by Year of Study

Study Year/ Faculty	Statistics Support Usage				Mathematics Support Usage			
	Foundation & Year 1	Year 2	Year 3	Year 4 & Plus	Foundation & Year 1	Year 2	Year 3	Year 4 & Plus
Arts	0	0	4	4	1	0	0	0
Engineering	6	9	6	11	867	224	43	18
Medicine	33	12	24	18	3	0	0	1
Pure Science	19	22	19	5	106	49	21	4
Social Sciences	62	37	59	13	86	30	44	4
Total	120	80	112	51	1063	303	108	27

Support usage by year 1 students is significant higher than that of students in other years of study; 120 for statistics help and 1063 for maths help, indicating the transitional support role of MASH.

STATISTICS NEEDS ANALYSIS

In order to ascertain the needs for statistics help in UoS a needs analysis audit was carried out in 2009. The purpose of the audit was to gather information of statistics support provision already available within departments and to identify additional statistics support needs within each department. This would enable MASH to target their resources appropriately and allow for the development of effective statistics support.

The statistics tutors (and joint authors) carried out the audit through a mixture of visits, telephone calls and questionnaires emailed to the Directors of Teaching and Learning to be complete by appropriate academics within the departments. Unfortunately, the rate of response was very low and the audit has not given the desired fuller picture, and a further questionnaire will go out but this time to students to get their perspective, results are anticipated at the end of the spring semester 2010. Of all the departments that participated in the audit, the ones that had statistics needs were already provided modules or courses that covered statistical topics and said that these were sufficient to cover all their requirements. Only one department, Sociology, admitted that their programme of study did not dedicate enough time to statistics and therefore will be including an extra module from 2010/11. This could explain the high usage of statistics support by the Social Sciences departments (Table 4).

The need for statistics was seen at all the different levels (undergraduate and postgraduate) but it varied between departments. The Engineering departments said that the need was concentrated at the undergraduate level. Postgraduate students had access to quantitative modules through the Research Training Programs if there was a need for statistics at this level and additionally some departments allocated a tutor (in some cases a dedicated tutor) to support students. For example in the Department of Politics there is a politics lecturer whose specialism is in statistics. However, despite the statements of adequate provision our figures and experience give a different picture whereby undergraduates and postgraduates are coming for help with little preparation. The possible areas that statistics support can help as highlighted through the audit are; more drop-in sessions, workshops addressing basic gaps in statistical skills, extra classes and support in analysing experimental data. External audit of statistics support within HEI's (includes Red Brick and Russell Group) provide a variety of methods used to help students carrying out research projects.

- Statistics Help-desk
- Statistical Advisory Service (SAS) – for staff and/or students
- Statistical computing advice
- One-to-one drop-in sessions
- Small group tutoring
- Workshop tuition.

In the Spring of 2005 the Universities of Loughborough and Coventry were awarded the Centre for Excellence in Teaching and Learning (CETL) award and given funding to develop effective maths and statistics support throughout the HE environment. Both universities have successfully set-up a SAS (Smith & Gadsden, 2006) and provide a good model of practice.

FUTURE DEVELOPMENTS

The methods and practice used by other support centres will be examined for appropriateness for UoS, not all of these areas fall within the MASH remit which is to enhance and not to substitute for departments curriculum, certainly the additional drop-in sessions and specific workshops are good methods and it is hoped the questionnaire planned to go out to students will further help with more specific information for the development of and improving statistics support.

REFERENCES

- Beveridge, I. (1997). Survey; Learning support for mathematics in FE and HE. *Mathematics Support Association Newsletter*, 6, 20-23.
- Beveridge, I., & Bhanot, R. (1994). Maths Support Survey: An Examination of Maths Support in Further and Higher Education. *Mathematics Support Newsletter*, 13.
- Clark, C. (2003). *The Future of Higher Education*. London: HMSO.
- Gill, O., O'Donoghue, J., & Johnson, P. (2008). *An Audit of Mathematical Support Provision in Irish Third Level Institutions*. Limerick: CEMTL, University of Limerick. Document Number)
- Lawson, D. A., Croft, A. C., & Halpin, M. (2003). Good Practice in the Provision of Mathematics Support Centres. *LTSN Maths, Stats & OR Network*.
- MacGillivray, H. (2008). *Learning Support in mathematics and statistics in Australian universities—a guide for the university sector*. Strawberry Hills: The Australian Learning and Teaching Council. Document Number)
- Perkin, G., & Croft, A. C. (2004). Mathematics Support Centres—the extent of current provision. *MSOR Connections*, 4, 14-18.
- Samuels, P., & Patel, C. (2009). *Scholarship in Mathematics Support Services*. Paper presented at the The London Scholarship of Teaching & Learning 7th International Conference.
- Smith, K., & Gadsden, R. (2006). Sigma SAS Rescuing Projects. *Paper presented at the CETL-MSOR Conference 2006, Loughborough*.