Accounting students' IT application skills over a 10 year period

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Abstract

This paper reports on the changing nature of a range of information technology (IT) application skills that students declare on entering an accounting degree over the period from 1996 to 2006. Accounting educators need to be aware of the IT skills students bring with them to university because of the implications this has for learning and teaching within the discipline and the importance of both general and specific IT skills within the practice and craft of accounting. Additionally, IT skills constitute a significant element within the portfolio of employability skills that are increasingly demanded by employers and emphasised within the overall Higher Education (HE) agenda (e.g. SHEFC, 2005)

The analysis of students' reported IT application skills on entry to university, across a range of the most relevant areas of IT use in accounting, suggest that their skills have continued to improve over time. However, there are significant differential patterns of change through the years and within cohorts. The paper addresses the generalisability of these findings and discusses the implications of these factors for accounting educators, including the importance of recognising the differences that are potentially masked by the general increase in skills; the need for further research into the changing nature, and implications, of the gender gap in entrants' IT application skills; and the low levels of entrants' spreadsheet and database skills that are a cause for concern.

Keywords: *Education, Information Technology (IT), Computer Applications, Skills, Computer Literacy, Gender/Sex.*

Introduction: IT application skills, students and accounting degrees

IT skills are one of the subsets of the employability skills that are increasingly on the Higher Education (HE) agenda (e.g. SHEFC, 2005; Critical Thinking *et al.* 2003). As discussed in Stoner (1999) and McCourt Larres *et al.* (2003) the levels of IT skills students bring with them into HE, and to accounting degrees in particular, have important consequences for what we need to teach and what we can assume about our students' learning needs: both with respect to the generic employability skills that are demanded by employers, and for the subject related IT skills which are part of the craft and essential learning environment of Accounting.

This paper reports on a set of IT skills defined primarily by those that were most relevant to accounting students at the start of the data collection period (1996): namely generic PC use (Windows), use of spreadsheet and word processing application software, utilisation of e-mail for communication and the WWW for information retrieval, and, to a limited extent, the use of statistical and database management applications. This set of 'IT application skills' matches the majority of the current 'user role competencies' relating to the 'application of appropriate IT tools to business accounting problems' defined by the International Federation of Accountants (IFAC, 2003a, Information Technology for Professional Accountants, Appendix 3). With the exception of presentation software skills[1], these are the types of IT use and application skills that we might reasonably expect of entrants to accounting degrees today.[2] There are a host of other IT related topics that accountants might be expected to be aware of, for example data communications, networking, security and control, systems analysis and design, and e-business applications. IT skills of these types were not included in this survey: mainly as they were not the type of skills that students would have had when data collection started. However, their absence from the survey is not a major issue, as they are not skills that even today we would expect most accounting student entrants to HE to possess.

The importance of IT skills within accounting and finance degrees and the accounting profession is discussed in detail in, for example, Stoner (1999) and McCourt Larres *et al.* (2003). In short it is evident that the profession sees IT skills as a fundamental requirement for good professionals (Institute of Chartered Accountants in England and Wales, 1989, 1996, 1997a and 1997b, Chartered Institute of Management Accountants, 1996, Harris, 1997 and Cole, 1996) and that accounting educators see IT skills as an essential part of the teaching and learning of accounting and finance, a set of important 'key' or 'transferable' skills that should be integrated within the curriculum (Bhaskar, 1982; 1983, Collins, 1983, Bhaskar and Kaye, 1985, Er and Ng, 1989, Collier *et al.*, 1990, Williams, 1991, Wildey, 1990/1991, Togo and McNamee, 1995, Sangster, 1992, Gazely and Pybus, 1997, Nicholson, 1997, Crawford and Barr, 1998, and Stoner, 1996b; 1997; 1999, Arguero Montano *et al.*, 2001, Gammie *et al.*,2002, Chang and Hwang, 2003).

The importance of IT to the accounting profession is also indicated by recent initiatives of the profession, including those of IFAC's education committee (International Federation of Accountants, 2003a; 2003b) and the statement 'Global Capital Markets and The Global Economy: a Vision from the CEOs of the international audit networks' (November 2006), in which the CEOs of the 6 largest international audit firms state:

> 'Today, it would be almost impossible to find an auditor without [a personal computer], or without the skills to operate any of a wide variety of software programs that companies now use to organize and analyze information about their operations.
> **We couldn't operate without having professionals with this expertise.'**
> (DiPiazza *et al.*, 2006 p. 20, emphasis added)

Within the accounting and related disciplines, research that has explicitly investigated the IT skills of students includes Stoner and Nisbet (1989), Brudney *et al.* (1993), Gazely and Pybus (1997), Pybus (1997), Marriott (1997), and Stoner (1999), McCourt Larres *et al.* (2003) and to some extent Gammie *et al.* (2002). These studies stress the importance of IT skills to the disciplines of accounting and finance and/or for the study of those disciplines, and in general limit their consideration to the same IT skills covered in this paper, though some (including Gammie *et al*. 2002 and McCourt Larres *et al*. 2003) add presentation software skills. Stoner (1999), covering the same set of IT skills covered in this paper, provides evidence on IT skills at entry to university, including the relative paucity of skills in the use of spreadsheets and databases systems, two of the key IT Skills areas identified by IFAC (2003a).

This paper investigates three questions which arise from the reported increases in IT skills between 1996 and 1997 reported by Stoner (1999):

- Were the IT skills characteristics of students changing through time?
  In particular, was there any difference in IT skills at entrance between the 1996 to 2001 and 2006 cohorts?
- Are entrants' IT skills in the accounting related specialist areas of spreadsheets and database management systems changing in-line with general levels of IT skills?
- Is it possible to identify relationships between IT skills and student characteristics, for example, gender, ethnic origin, age at entry, social-economic background and pre university studies?

The analysis suggests that we are still far from being able to assume universally adequate IT Skills and that there are significant differential aspects to entrants' skills profiles, indicating that it is still incumbent on the accounting HE sector to recognise the deficiencies in and diversity of students' IT skills at entry. The identified changes in the gender gap indicate the need for further research, and the low levels of entrants' spreadsheet and database skills are a cause for concern.

Context and Background

This study took place within a department of a large Scottish University where the main undergraduate course is a specialised accounting and finance degree. Combined with an accounting and law degree, the annual undergraduate intake to the Department over the period of the study was between 80 and 125 students, with few entrants to the accounting and law degree. Almost all of the entrants came to the University directly after finishing their secondary schooling, and the vast majority came from schools in Scotland. Over 96% of entrants included in the survey were UK nationals and over 91% had home addresses in Scotland: none of the non UK student groups represent more than 0.9% of the sample and entrants with non-Scottish UK domicile are approximately evenly split from England and Northern Ireland. The standard of students entering the Department is high, most having gained high grade passes in their end of school national examinations.[3] The intake profile remained relatively constant, including a gender split of approximately 52-55% male over the period.

Data collection

The data used in this paper was collected from first year students attending the first meeting of the main first year class in accounting during each of the six academic years from 1996/97 to 2001/02 and for 2006. The data from the first two cohorts (entrants in 1996/97 and 1997/98) formed the basis of the analysis reported in Stoner (1999).

The questionnaire

A single page questionnaire was used: the same instrument used by Stoner (1999). The seven IT skills areas surveyed are detailed in Table 1.

[Table 1~ here]

For each skill area students were asked to score themselves on a 5-point scale for each of the three questions shown in Table 2.

[Table 2 ~here]

The response descriptors for the self-**rating** of skills were provided to guide students and to put their answers in context. Questions on **confidence** were asked as it is believed to be related to the effectiveness of students' use of those their skills in their learning. Questions on **usage** were asked to obtain relatively interpretation-free data on each student's regularity of using their skills. The resulting 21 variables used in this paper are coded by the combination of the skill area letter (Table 1) and the skill aspect (Table 2). The questionnaire (which is available from the author on request) also collected student identities to facilitate analysis against student registration data. This non-anonymity causes some potential concern: that this may cause response bias. To minimise any potential here students were assured at the time it was administered that the data was to be used for research purposes only, also the text on the form indicated that it was not a test, but was to be used to establish any general need for the provision of additional IT training. Further, identification was required to match students with existing biographical data, without which it would have been necessary to ask detailed questions in the survey. It was felt that this approach was more likely to sensitise students than asking for their student number, and therefore both bias responses and lead to reduced response rates.

Use of self-assessed skills ratings

The data on skills used in this paper is based on students' self-assessments of their skills, usage and confidence. The use of self-assessment instruments of this type is not without problems. Indeed, criticising the self-ratings used in Stoner 1999, which are also used here, McCourt Larres *et al.* (2003) conclude 'These findings indicate that self-assessment is not an appropriate means of determining computer literacy among entry-level undergraduate accounting students when used in isolation.' (p. 97). At face value this seems to invalidate the foundations of the analysis in this paper; however their argument has two fundamental weaknesses in relation to this research.[4]

Firstly, their argument is based on a questionable comparison; of self-assessed skills with the results of a multiple-choice objective test '… designed to elicit an objective measure of students' computer literacy.' (p. 104). The issue here is that the objective test of computer literacy used in their study is a measure of knowledge or understanding and not a measure of computer literacy even in their own terms: they define computer literacy as '…the ability to <u>use</u> microcomputers confidently …' (p. 99, emphasis added). This is a definition of computer literacy that is rooted in competency, the ability to use the technology, a notion closely related to the IT application skills addressed in the survey reported here. It is widely accepted, at least in other disciplines - see for example Poikela, 2004 (work-based learning), Bann *et al.*, 2005 (medicine) and Scott *et al.*, 2001 (dentistry) - that the assessment of skills (as opposed to knowledge and understanding) with examination type testing is very problematic, as skills are best assessed by observation (Gazely and Pybus, 1997), to enable a judgment of whether students '… can put that knowledge into action.' (Stoner, 1999, p. 234): a position that is reflected in IFAC's competency based consideration of skills assessment (2003b, paragraphs 109-126) and in Selwyn's statement (in the context of an argument that is generally critical of the use of survey methods at high school level) '… it seems incredible not to measure an individual's expertise and skills without actually using a computer.' (1997, p. 56). Holmes (2001) goes further, even casting doubt on the possibility of objectively observable performance, in effect suggesting that assessment of someone's skills requires the interpretation '… of activity as performance-of-a-kind.' (p. 114).

Secondly, whilst there is evidence that suggests students' self-assessments are, to some extent, unreliable, there is also evidence to suggest that they can be useful in themselves or as indicators of the underlying skills. Dunning *et al.* (2004, p, 70) suggest that even the modest correlations of self-ratings to actual skills are none-the-less useful and that 'People fall prey to biases that leave their self-assessments flawed in systematic ways…' (p. 70), an observation similar to those on self-leniency in, for example, van Vliet *et al*. (1994). As these self-assessment biases tend to be systematic, it is arguable that the bias is less importance when looking at changes or differences in skill level. Support for the validity of student self-assessments is also provided by some of the literature on self and peer assessment (including Dochy *et al*., 1999 and Sullivan and Hall, 1997). Another line of support for self-assessments comes from findings of conditional support. Farh and Dobbins (1989) observe that access to comparative performance information improves subjects' self-assessments of their skills. McCourt Larres *et al.* (2003), Mabe and West (1982) and van Vliet *et al*. (1994) all report low or insignificant levels of self-leniency in specified circumstances, for example when the students are highly able. The students surveyed in this study are all of a high quality, based on their entrance qualifications, which provides some comfort that one of these conditions applies. The likelihood that these students have reasonably good, if informal, information on their peers' comparative performance, through their use of at least some of the surveyed skills in collaborative or common environments (for example at school and at home) and, at least more recently, when involved in on-line interaction with their peers, may well also provide conditions which are likely to result in self-assessments that reflect their real underlying skill levels.

Given these arguments, and the fact that the cost and inconvenience of attempting to assess students' skills in a rigorous way - i.e. by observing and evaluating their employment of those skills, it is unsurprising that self-assessment has support from others (including, Draper *et al.*, 1996, Creanor *et al.*, 1995, Yorke, 2001, Lee, 2003, Haywood *et al.*, 2004 and Thorpe and Wilmut, 2004). Additionally, Lizzo and Wilson (2004) defend the use of self-assessed skills, concluding that 'First-year students appear to be able to make personally meaningful and coherent judgments of their strengths and weakness …' (p 124). Therefore, though it is clear that the self-assessed measures used in this survey - which are students' evaluations of their perceptions of their skills - do not provide perfect measures of students' skills, they are defensible measures that are widely used and accepted, particularly in circumstances where errors on individual students' assessments are not critical, for example in investigations with a policy focus.

Analysis and Results

The response scale data used in this study is measured on an ordinal scale. Therefore it is arguable that the data does not strictly meet the interval scale criteria required of parametric tests (Siegal and Castellan, 1988). Despite this, the use of parametric techniques on this type of data is often justified (eg Marriott 1997, Lizzo and Wilson 2004)) and preferred by some researchers. Consequently, parametric and non-parametric test results are reported.

Exploring the data

Tables 3 and 4 show respectively the within skill and between skill Spearman correlations coefficients of the main variables based on the entire data set (over all the cohorts at entry). All the correlations are significant at the 99% significance levels, though the sizes of the coefficients vary.

[Table ~3 here]

Table 4 indicates that within each skill surveyed there is a high degree of correlation among the three variables; self-assessed skill rating, confidence and use. In each case the highest correlation is between skill rating and confidence (0.962 to 0.820). Though the degree of correlation might indicate that the scores are essentially measuring the same things, the differences between the descriptive statistics (e.g. the means in Table 5) within each skill area suggest that this may not be the case.

[Tables ~4a,b and c here]

When looked at in combination with the mean scores (Table 5) the following observations can be made with regards to the skills correlation statistics in Table 4:

- The significant correlations for all pairs of variables suggest that students' reported skill scores are all related across the different skills.

- The highest correlation is between e-mail and WWW (internet) skills. It is of course possible that students see these skills as essentially the same thing: failing to distinguish between them as their use of Web based mail systems are seen as part of their internet skills.
- Windows skills are highly correlated with all skills except for statistical analysis skills.
- Statistical package skills show low correlations with all other variables. The lowest mean usage score suggests this is a result of the expected low exposure to such packages.
- Database skills are most highly correlated with spreadsheet skills (and spreadsheets to databases). This might be expected to some extent because of the nature of these applications. However evidence from teaching databases to these students (in year 2) suggests that few students have previous exposure to database management systems. It therefore seems that this high correlation is more likely to be indicative that students misunderstand the intended nature of database skills, confusing the meaning of database management system skills with the oft-taught use of spreadsheets for quasi database data handling.

The last two of the skill areas surveyed are fairly specialist and potentially advanced topics. Therefore *a priori* we would expect low entry values for many students. This together with the decreased variability in the variable values contributes to the low correlations and, further, suggests that it may be appropriate to exclude theses variables from some of the analysis.

Overall differences between cohorts at entry

The basic question here is one of difference: was there any? In a formal sense we have a null hypothesis that there is no difference between the cohorts of students. The mean value for each scaled variable is reported in Table 5a, together with the mean values in the first, last and middle years of the 10 year period, and calculated differences in the mean scores over each of two dividing five year differences; 1996 to 2001 and 2001 to 2006.

To examine whether the apparent differences are significant, the results of t-tests and Wilcoxon rank sum test (or Mann-Whitney-Wilcoxon test) are reported in Table 5b.[5] In addition to the raw score data, Tables 5a and 5b include an overall skill index (s_ym) which is discussed in the following section.

[Tables~ 5a and b here]

In the first of the two five year periods self-reported skill ratings, confidence and usage all show significant (at 99%) increases with the single exception of database usage (du). The scale of differences varies substantially. E-mail and internet skills show the largest improvement (approximately 2 response levels), followed by Windows skills (over 1 level) and word-processing (almost 1 level). The remaining skills areas (spreadsheeting, statistics package and database skills) increase by around half a response level. In the second half of the survey period only e-mail, the internet, Windows and word-processing skill levels increase significantly, and then by much smaller amounts. The other skill areas (spreadsheeting, statistics package and database skills) show no significant change in the second five-year period.

The changes in reported skill levels between individual years within the first 5 year period (not reported in detail) indicate that the large and almost universally significant differences over the first year of the 10 year period reported by Stoner (1999) are not repeated in subsequent individual years. Generally over this 5 year period the pattern of change appears as one of a gradual increase in scores following the rapid increases between the 1996 and 1997 entrants. A few single year differences indicate decreased reported skill levels, and significant individual year changes cluster in the internet, e-mail and windows skill areas[6].

Identifying general changes in skills levels

In order to capture and illustrate overall reported IT application skill levels an index (**s_ym**) was calculated for each entrant based on the un-weighted mean value of the rating, use and confidence scores for the first five of the seven skills areas (excluding the statistical and database skills). Whilst the calculation of such an index is problematic because of the ordinal rather than interval nature of the scores data, it is clear from the box-plot (Figure 1) that there are general increases in this skills index over time, along with increases in the diversity of skills levels within cohorts. Further, the Cronbach's alpha reliability coefficient of the data set is 0.941 (0.917 over the 5 main skill areas): indicating that the internal reliability of the index is well within acceptable limits (Brown, 2006 following Kline, 1999).

[Figures 1 here]

Identifying diversity / groups within the cohorts

The summarised distribution data in Table 6 sets out the percentage of students who responded with low ('inadequate') self-assessed skills compared with those reporting high ('better than adequate') self-assessed skills. The data suggests that, even in the later cohort, there is considerable diversity of skill levels within the cohorts.

Though the proportion of students reporting 'inadequate' skill levels has generally decreased over the years, it is clear that even in 2001 at least significant minorities of the students believed that they were in need of IT skills development, with the exception of Windows and word-processing skills. However, by 2006 95% of entrants report at least adequate skill levels for all areas except spreadsheeting and the two specialised areas, statistical packages and databases. A similar pattern is reflected in the proportions reporting 'better than adequate' skill levels; in the core areas only spreadsheet skills failing to reach at least 80% of students at these levels.

Given that spreadsheet skills represent one of the main IT skills required of accountants in the workplace, the fact that even by 2006 20% of students report inadequate skill levels, with only 36% above adequate, is significant for accounting education.

[Table 6 ~ here]

Adapting the methodology of Stoner (1999), which is similar to that used by Duff (2004), the aggregate (pooled) data on self-rating, use and confidence levels for the 5 core skills areas for all cohorts was subjected to cluster analysis. The SPSS K-Means Cluster Analysis procedure was used to identify two clusters. Table 7 contains the statistics that define the cluster centres of each group. This shows that those in Group 1 assessed themselves as having higher skills confidence and usage in all areas than those in Group 2. The greatest differences are in the Internet related areas (WWW and e-mail), with cluster centre differences of over two response levels. Other variables show a difference of approximately one response level or less. The difference between the groups can be characterised as being based on relative expertise and confidence: for convenience the groups are labelled 'proficient' and 'novice'.

[Table 7 ~ here]

This is clearly a tentative finding, not least because of the potential problems associated with using a parametric clustering technique with data of the nature available and the potential problems associated with interpreting the cluster centre statistics. However, performing the cluster analysis on different subsets of the 21 variables produces similar results with similar cluster groupings. This suggests that the observation that there appears to be at least two groups of students whom it might be relevant to treat differently with respect to IT application skills training, appears robust. The box-plot of the index variable by year and cluster grouping (Figure 2) illustrates the extent of the overall differences.

[Figure 2~ here]

Table 8 shows an analysis of the proportions of students in each of the two cluster groups by cohort. The reported Chi-squared tests indicates that the cohort compositions are significantly different (at 99%): the proportion of IT application 'proficient' students rising from 6% to 74% in 2001 and 94% in 2006.

[Table 8 ~ here]

Investigating Students' characteristics at entry

As a preliminary to incorporation of the variables into a general linear mode a series of one way ANOVA tests were carried out to investigate if IT application skills levels (both cluster membership and the IT application skills index) are related to the variance in students' characteristics. The results (not reported in detail) indicate that;

- the year of entry and whether or not the student studied computing at school (IT@School) and their weighted score in Higher exams are significantly related to both 'IT application proficiency' and the IT application skills index, and
- students' gender and age on entry are significantly related to either the IT application skills index or cluster membership.

The ANOVA tests therefore indicates that the other variables, including ethnic group, social-economic group of parent and overall admittance score (including non-Higher results) show no relationship to these measures of overall IT application skills. The most influential single factor in the ANOVA is year of entry.

Investigating the combined effect of the potential significant factors.

The one-way ANOVA indicates which factors are not likely to be significant in driving the IT application skills of entrants (e.g. ethnicity and social group), however this model does not indicate which variables are significant as it looks at each variable independently. A simple linear regression model of the independent variables, year, sex, age, higher score and whether or not computing was studied at school, against the IT application skills index produces the results summarised in Table 9. These indicate that the variables session (year of entry), sex (gender) and IT@school are significant, whilst age and higher score are not, and are therefore excluded.

[Table 9 ~here]

Although the data doesn't meet the strict requirements of parametric linear regression, its use is defensible based on an investigation of the frequency distribution of the index variable (s_ym), which indicates that its distribution is not far from normal (Figure 3), and the evidence in the residual plots (Figure 4) that suggests the model fits reasonably well.

[Figure 3 here]

[Figures 4a and b here]

These results suggest the IT Application Skills model (as measured by the index):

$$s\_ym = 2.442 + 0.169 * year + 0.267 * IT@school_{\{0 \text{ for no: } 1 \text{ for yes}\}} - 0.137 * sex_{\{1 \text{ for male: } 2 \text{ for female}\}}$$

Therefore: for each year the mean score increases by 0.169
studying computing at school increases the mean score by 0.267
being female reduces a subject's score by 0.137.

The variables in the model provide evidence that the most important determinates of IT application skills in addition to year of entry are gender and prior study of IT.

Investigating the gender difference

Table 10 compares the mean self-assessed scores for male and female students in 2006 with that from the earlier periods, together with differences and significance test results on the differences (Chi-squared, t-test and Mann-Whitney-Wilcoxon Z). For the pre 2006 data the overall score difference (s_ym) is significant, females scoring themselves 0.19 lower than the males, and in all but two cases (tu and du) the mean female score is lower than the mean male score, though not all differences are significant. The pattern of differences shown indicates that the biggest significant differences are in the skills related to the WWW, where the mean female score is approximately 0.4 of a response category lower: a finding broadly consistent with those of others, including Simpson *et al.* (1997). The other area of consistent significant difference relates to general Windows skills, where female mean scores are approximately a quarter of a response category lower than male students. These early period gender differences amongst accounting students are, in general terms, consistent with those found by others, though the results here indicate that the differences are not even across the different IT application skills.

[Table 10 here]

Clearly gender appears to have been an important influence in certain aspects of the surveyed IT skills profiles of entering students. However the analysis of the 2006 student cohort shows a very different pattern, the differences are generally smaller but, more importantly, none of the gender differences are significant, even at the 95% level using any of the 3 test statistics. It therefore appears that the self-reported gender differences have become insignificant in the most recent cohort.

These results of gender difference using self-assessed ratings do, however, have to be considered with care. It has been observed that differences may, at least in part, be an attribute of the gender differences in attitudes to self-assessment: females tending to under report skills despite having broadly equivalent skill levels (Whittle and Eaton, 2001, Lee, 2003). These authors suggest that this is associated with females' lower levels of confidence. A factor that may be hinted at here in the earlier period data in so far as for all the categories of skills surveyed the female score deficit is greater for the confidence variable than for rating or usage; an observation not repeated in the 2006 cohort. It has been further suggested that these differences are affected by female attitudes to IT in general: 'The commission makes it clear that girls are critical of the computer culture, not computer phobic,' (Sherry Turkle: Web preface to AAUW: 2000).

Discussion and implications

IT skills constitute a significant element of the employability agenda that is current in Higher Education. The IT application skills that students bring with them to University are therefore important, and the analysis here suggests that the IT application skills with which students enter their university accounting studies are continuing to improve through time, albeit at a slower rate than reported in Stoner (1999) over the first year covered by this data. The findings of this survey are based on students' self-assessments of their skills and on their reported confidence in, and usage of, those skills; as discussed in the section on self-assessed skills above the results should therefore be interpreted with care.

Within this overall context, of higher reported IT application skills, it is important that educators do not lose sight of the diversity and patterns of entrants' skills that could be obscured by this general increase, and which have potentially important implications for accounting education. The results of this survey indicate that self-reported word-processing, Windows, e-mail and internet skill levels appear to be reaching, at least for many students, a plateau of 'good' or better levels: internet skills and e-mail skills having improved rapidly over this period. However the results also identify three significant issues with potentially important implications for accounting education: gender differences and inadequate database and spreadsheet skills. Whittle and Eaton (2004) similarly commented on the surprising levels of inadequate skills, including high levels of inexperienced spreadsheet users (50%) and database users (67%). An additional issue discussed is the generalisability of the findings.

Gender

Apart from the (unsurprising) effects of time and whether or not students studied computing related subjects at school, gender appears to be the only significant factor in the determination of students' self-reported IT skills on entry to this accounting degree. This significant effect of gender, at least in the early part of the period, is consistent with findings of others (Madigan, 1995, Munro *et al.*, 1997, Whittle and Eaton, 2001, Lee, 2003). However, an important finding in this data is that not only has this difference decreased over time, the differences in the most recent cohort are insignificant across all of the IT application skills surveyed, including the confidence scores. To a degree this equalisation of the gender difference is reported elsewhere: recently by, for example, Hoffman and Vance (2007) and Madigan *et al*. (2007) and longer ago by van Vliet *et al*. (1994). However the results in both the recent studies show remaining patterns of significant difference at a detailed level, unlike this study, characterised as females assessing themselves less able in the more technical (as opposed to application or communication) areas. The apparent change in the gender differences, both self-ratings and confidence, is socially and educationally significant and, though beyond the scope of this paper, is worthy of further research.

Database skills

Database skills are likely to be one of the most important IT skills areas for the future of accounting, as reflected, for example, in the profession's recent acceptance of the need to consider alternative financial reporting structures (DiPiazza *et al.* 2006) possibly based on XBRL (which is, in effect, a web language based on a database model).

The results of this survey indicate that entrants' skills in this area are low and have hardly progressed since 1997, and there are some indications that even the reported skills are exaggerated because of students' confusion of database skills with data handling skills, for example within spreadsheets. To a large extent this skill deficit is neither surprising nor particularly worrying as accounting educators are unlikely to assume high skills in this area. The increased importance of this aspect of information systems technology does, however, have to be reflected in changes in the accounting curriculum and accounting faculties' attitude to this topic.

Spreadsheet skills

The low level and relatively slow improvement of reported self-assessed spreadsheet skills amongst entrants is very disappointing, especially considering the central role of spreadsheet modelling in the practice (IFAC, 2003a) and education (e.g Marriot, 2005) of accounting and finance. The potential problem here is serious particularly as this is a skill area that is often assumed to be generic by many accounting educators. Admittedly the challenge for accounting educators has not worsened, however, there is a serious risk that the impression of generally improving entrant IT application skills will lead us into a false belief that there is a decreasing need to address this particular skill deficit within our curriculum.

Generalisability

This study focuses on accounting and finance students in one university; thereby raising questions about the generalisability of the findings. However, the general trends and patterns of the self-reported skills levels described here have been demonstrated to be similar to those reported in studies in other disciplines and other similar countries. For example, despite the skills level increases reported here there are several areas where at least significant minorities of students report inadequate IT application skills: a result consistent with recent findings amongst medical student entrants (Whittle and Eaton, 2004).

Clearly however, this study was carried out in a country with relatively high levels of IT exposure and access: an appropriate measure of which is the proportion of the population that has access to the Internet. Within the UK it is estimated that approximately 63% of the population currently have access to the Internet, rising from 26% in 2000 (Internet World Stats, 2006), and probably less than 10% in 1996. The same source gives the current world average as 16.6%, and indicates that almost all counties in Africa and Central America; most in Asia, South America and the Middle East; and several counties in other parts of the word (including several countries in Eastern Europe) have internet access levels below those of 2000 in the UK. These statistics suggest that, in effect, these counties are generally at a different stage of IT development and penetration and are not therefore directly comparable. However, it is arguable that the findings here are, albeit problematically, generalisable to such populations provided the time shift is recognised. It should be noted that the effect of this time/development difference to accounting educators in the HE sector is likely to be mitigated, to some extent, by differences in the relative HE participation rates. It is likely that Internet access rates are related to education achievements and economic status, factors that are also related to HE participation. Participation rates in Scotland (c.50%) are relatively high compared with many of the countries with low levels of Internet access.

Conclusion

The findings of this survey of students' self-assessed IT application skills are likely to be broadly reflective of students on other programs of study in other locations, particularly in relation to the pattern of changes over time, provided allowance is made for the effect of relative levels of IT access, development and penetration. The implications of the research are therefore of potential interest to accounting educators even in dissimilar environments. For example, an awareness of the likely differential rates of students' IT application skill changes could enable action to be taken to ensure appropriate inclusion of IT skills in the changing accounting curriculum.

The tentative finding that the previously reported gender gap in IT skills, at least in relation to the surveyed application areas, seems to be diminishing is potentially significant and worthy of further research, but indicates that this source of diversity appears to becoming less important with time. The overall indications are, however, that there will be some continued diversity in entrants' IT application skills: differences that we will probably need to cater for into the foreseeable future.

The main practical lessons of this survey for accounting education are that we need to continue to deal with a wide diversity of entrant students' skills, and confidence in those skills, in these IT application areas, particularly as the problem of diversity may now be masked by the general increase in students' IT skills. In this context it is important that the continued relative paucity of entrants' skills in spreadsheets and databases, key areas for our discipline, continue to be addressed in the accounting curriculum: otherwise we may fail to provide students with the skills to use these tools which have great potential to enhance their learning and understanding of theoretical aspects of the discipline as well as providing skills important to meet the employability agenda in contemporary Higher Education.

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Notes

[Endnotes are presented after the tables and figures.]

Tables

Table 1: The IT skills areas covered by the questionnaire

Skill area	additional explanation	Variable indicator	
Use of Windows	- to access / run applications and to store / retrieve / print data / files and cut and paste between applications.	**w**	**w**indows
Building and using spreadsheet models	- to analyse problems and create reports	**s**	**s**preadsheet
Using a Word processing Package	- to create and edit essays / reports / letters	**t**	**t**yping
Using e-mail	- to receive and send messages	**e**	**e**-mail
Using the World Wide Web	- accessing and searching for information	**i**	**i**nternet
Using statistical packages to analyse data		**a**	stat's **a**nalysis
Using a database package	- to create a data resource and to store, retrieve and relate data	**d**	**d**atabase

Table 2: The meanings attached to the 5-point scale responses (as detailed in the questionnaire)

How do you rate your skill?	How much do you use this skill?	How confident are you in your skill?
1 - Non – existant **2 - Some**, but not at an adequate level **3 - Adequate**, I can get by. **4 - Good**, I can do most of what I want to do. **5 - Excellent**, no problems that I cannot solve.	**1 - Never** **2 - Sometimes**, but not regularly **3 - Regularly**, at least once per week **4 - Quite often**, several times a week **5 - A lot**	**1 - No confidence** **2 - Little confidence** **3 - Some confidence** **4 - Confident** **5 - Very confident**
Variable: r (rate)	**u** (use)	**c**(confidence)

Table 3; Within Skill Correlation Coefficients: between rate (r), confidence (c) and use (u).

windows skills			spreadsheet skills			word-processing skills		
	wu	**wc**		**su**	**sc**		**tu**	**tc**
wr	.708**	**.822****	**sr**	.643**	**.853****	**tr**	.613**	**.820****
wu		.736**	**su**		.668**	**tu**		.627**

e-mail skills			WWW skills		
	eu	**ec**		**iu**	**ic**
er	.903**	**.962****	**ir**	.900**	**.953****
eu		.914**	**iu**		.911**

statistic package skills			database skills		
	au	**ac**		**du**	**dc**
ar	.751**	**.916****	**dr**	.704**	**.906****
au		.774**	**du**		.727**

Spearman correlation coefficients (rho)

** = significant at 99% (2 tailed)

The largest coefficient within in each skill is shown **Bold**

As the data is non-parametric and ties are not expected to be a problem Spearman correlations is reported in preference to both Pearson and Kendal correlations.
Pearson's parametric correlation coefficients (not reported) are of a very similar scale and all but one of the significance levels are identical.
Kendal's correlation coefficients (not reported) are generally moderately lower but are all significant at 99%.

Table 4a: Between Skills Correlations – Rating (r) variables						
	wr	**sr**	**tr**	**er**	**ir**	**ar**
sr	***0.507*****					
tr	**0.666****	***0.461*****				
er	***0.496*****	0.272**	***0.473*****			
ir	***0.533*****	0.270**	**0.505****	**0.822****		
ar	0.240**	0.338**	0.250**	0.379**	0.381**	
dr	***0.485*****	**0.605****	***0.469*****	0.286**	0.329**	***0.444*****

Spearman correlation coefficients (rho), ** = significant at 99% (2 tailed)
Coefficients >.05 shown **Bold,** coefficients >.04, <.05 shown ***italic and bold***

Table 4b: Between Skills Correlations – Use (u) variables						
	wu	**su**	**tu**	**eu**	**iu**	**Au**
su	***0.418*****					
tu	**0.688****	***0.413*****				
eu	**0.553****	0.224**	***0.457*****			
iu	**0.623****	0.206**	***0.490*****	**0.818****		
au	0.205**	0.387**	0.216**	0.265**	0.253**	
du	0.322**	**0.511****	0.369**	0.184**	0.179**	***0.404*****

Spearman correlation coefficients (rho), ** = significant at 99% (2 tailed)
Coefficients >.05 shown **Bold,** coefficients >.04, <.05 shown ***italic and bold***

Table 4c: Between Skills Correlations – Confidence (c)						
	wc	**sc**	**tc**	**ec**	**ic**	**Ac**
sc	**0.524****					
tc	**0.690****	***0.459*****				
ec	***0.494*****	0.258**	***0.435*****			
ic	**0.524****	0.276**	***0.497*****	**0.817****		
ac	0.296**	0.355**	0.230**	0.387**	0.377**	
dc	***0.438*****	**0.571****	***0.427*****	0.282**	0.304**	***0.474*****

Spearman correlation coefficients (rho), ** = significant at 99% (2 tailed)
Coefficients >.05 shown **Bold,** coefficients >.04, <.05 shown ***italic and bold***

Table 5a:		*Summary of entry statistics by year of entry* (ratings, use and confidence)																					
Session	**n**	**wr**	**wu**	**wc**	**sr**	**su**	**sc**	**tr**	**tu**	**tc**	**er**	**eu**	**ec**	**ir**	**iu**	**ic**	**ar**	**au**	**ac**	**dr**	**du**	**dc**	**s_ym**
Means																							
All		3.45	2.74	3.26	2.72	1.91	2.51	3.85	3.01	3.65	2.37	2.15	2.32	2.62	2.37	2.51	1.43	1.25	1.41	2.43	1.76	2.26	2.76
1996	78	2.75	2.01	2.61	2.27	1.55	2.17	3.28	2.31	3.05	1.24	1.19	1.26	1.45	1.32	1.43	1.12	1.08	1.11	2.03	1.61	1.88	1.99
2001	107	3.80	3.21	3.60	2.94	2.09	2.76	4.08	3.31	3.89	3.41	3.06	3.27	3.68	3.37	3.55	1.62	1.32	1.57	2.67	1.84	2.49	3.33
2006	104	4.18	3.83	3.92	3.21	2.17	2.95	4.48	3.73	4.21	4.20	3.93	4.07	4.31	4.42	4.20	1.84	1.45	1.72	2.88	2.00	2.63	3.86
Differences																							
To-01	**1996-01**	**1.05**	**1.20**	**0.99**	**0.67**	**0.54**	**0.59**	**0.80**	**1.00**	**0.83**	**2.17**	**1.86**	**2.01**	**2.23**	**2.05**	**2.12**	**0.50**	**0.24**	**0.47**	**0.64**	**0.23**	**0.61**	**1.35**
	2001-06	**0.38**	**0.62**	**0.32**	**0.27**	**0.08**	**0.19**	**0.40**	**0.42**	**0.32**	**0.79**	**0.87**	**0.80**	**0.63**	**1.05**	**0.65**	**0.22**	**0.13**	**0.15**	**0.21**	**0.16**	**0.14**	**0.53**

Table 5b: **Tests of difference by year of entry**

** = significant difference at 99%, * = significant difference at 95%, ~ = difference not significant. (all 2 tail)
For each year in series, from year to 2001 (mid-year) and from years 1996, 1997 and 2001 to 2006

Session	**n**	**wr**	**wu**	**wc**	**sr**	**su**	**sc**	**tr**	**tu**	**tc**	**er**	**eu**	**ec**	**ir**	**iu**	**ic**	**ar**	**au**	**ac**	**dr**	**du**	**dc**	**s_ym**
T-Test: Significance of t																							
To-01	**1996-01**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	~	**	**
	2001-06	**	**	**	~	~	~	**	**	**	**	**	**	**	**	**	~	~	~	~	~	~	~
Wilcoxon: Significance of Z (Kolmogorov-Smirnov Z results all follow a very similar pattern[#])																							
To-01	**1996-01**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	~	**	**
	2001-06	**	**	*	~	~	~	**	**	*	**	**	**	**	**	**	~	~	~	~	~	~	~

Data for the intermediate years 1997 to 2000 not presented, but available from the author. For these years the pattern of changes is variable, with some negative movements over short periods, in general only the e-mail and internet, and to a lesser degree windows, skills show any consistent pattern of significant changes (n = between 94 and 104).

Table 6: Percentage of students assessing their skills as:								
'Inadequate' (response 1 or 2)		**wr**	**sr**	**tr**	**er**	**ir**	**ar**	**dr**
Year	1996	35%	60%	19%	94%	85%	96%	65%
	2001	9%	33%	7%	24%	13%	75%	42%
	2006	1%	20%	0%	5%	2%	76%	38%
Decrease	*1996-2001*	*26%*	*27%*	*12%*	*70%*	*72%*	*21%*	*23%*
	2001-2006	*8%*	*13%*	*7%*	*19%*	*11%*	*-1%*	*4%*
'Better than adequate' (4 or 5)		**wr**	**sr**	**tr**	**er**	**ir**	**ar**	**dr**
Year	1996	22%	16%	55%	1%	6%	0%	9%
	2001	69%	30%	81%	59%	68%	1%	26%
	2006	84%	36%	96%	81%	87%	8%	28%
Increase	*1996-1997*	*47%*	*14%*	*26%*	*58%*	*62%*	*1%*	*17%*
	2001-2006	*15%*	*6%*	*15%*	*22%*	*19%*	*7%*	*2%*

Table 7: Cluster data for all entrants 1996 to 2006: Cluster centre data for all included variables									
	Rate			**Use**			**Confidence**		
Skill area	**Group 1**	**Group 2**	*Difference*	**Group 1**	**Group 2**	*Difference*	**Group 1**	**Group 2**	*Difference*
Windows	4.09	3.09	***1.00***	3.60	2.28	***1.32***	3.88	2.90	*0.98*
Spreadsheets	3.12	2.52	*0.59*	2.20	1.73	*0.46*	2.90	2.30	*0.60*
Word-processing	4.37	3.60	*0.77*	3.69	2.63	***1.06***	4.17	3.36	*0.81*
e-mail	3.98	1.49	***2.49***	3.72	1.29	***2.43***	3.88	1.44	***2.44***
World Wide Web	4.10	1.79	***2.31***	4.02	1.51	***2.51***	4.00	1.68	***2.32***
Mean	*3.93*	*2.50*	*1.43*	*3.45*	*1.89*	*1.56*	*3.77*	*2.34*	*1.43*

Table 8: Cohort membership of the cluster groups and Chi-squared tests of independence

SESSION		Cluster Number		Total
		Novice	Proficient	
1996	**Count**	**71**	**3**	**74**
	%	95.9%	4.1%	100.0%
2001	**Count**	**27**	**75**	**102**
	%	26.5%	73.5%	100.0%
2006	**Count**	**6**	**96**	**102**
	%	5.9%	94.1%	100.0%
Total	**Count**	**104**	**174**	**278**
	%	62.6%	37.4%	100.0%

Chi-Square Tests

	Value	df	Sig.
Pearson Chi-Square	156.802	2	.000

Inclusion of cluster membership for the intermediate years 1997-2001, not presented but available from the author, shows as consistent switch from novice to proficient cluster membership (X^2 = 229:p=0.000)

Table 9: results of the linear regression of the self-reported skills index

Dependent Variable: S_YM

Coefficients	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Constant	**2.442**	.095		25.813	**.000**
Base_year[#]	**.169**	.009	.574	18.828	**.000**
IT@School-)	**.267**	.069	.120	3.891	**.000**
Sex(1=M,2=F)	**-.137**	.055	-.076	-2.473	**.014**
Model statistics	**R**	**R Square**	**Adjusted R^2**	**Model F**	**Sig.**
	.601	.362	**.359**	130.074	**.000**
Excluded Variables	**Beta In**	**t**	**Sig.**	**Partial Correlation**	**Collinearity Statistics**
higher_score	-.050	-1.508	.132	-.057	.847
age_on_entry	.020	.670	.503	.026	.974

Modeled in SPSS using stepwise regression on 'sparse' model, though results are consistent with / similar to other methods and use of the full model.
[#] Base_year (1996 = 0, 2006 = 10 etc) is used rather than session to clarify the presentation of the model.

Table 10: Male and Female Means and Differences: by raw variables and index

Variable / Index	Years 1996-2001 Male	Female	Diff'ce	Significance X^2	T	Z	Just 2006 Male	Female	Diff'ce	Significance X^2	T	Z	Decreased Difference
wr	3.56	3.33	0.23	*	**	**	4.31	4.04	0.27	~	~	~	-0.05
wu	2.85	2.62	0.23	*	*	*	3.87	3.78	0.09	~	~	~	0.14
wc	3.40	3.11	0.29	**	**	**	4.00	3.84	0.16	~	~	~	0.13
sr	2.73	2.70	0.04	~	~	~	3.26	3.16	0.10	~	~	~	-0.06
su	1.91	1.90	0.01	#	~	~	2.15	2.18	-0.04	~	~	~	0.05
sc	2.57	2.45	0.12	~	~	~	3.06	2.84	0.22	~	~	~	-0.10
tr	3.86	3.84	0.02	~	~	~	4.56	4.40	0.16	~	~	~	-0.13
tu	2.97	3.04	-0.07	~	~	~	3.65	3.82	-0.17	~	~	~	0.11
tc	3.67	3.63	0.04	~	~	~	4.26	4.16	0.10	~	~	~	-0.06
er	2.47	2.27	0.20	~	~	~	4.28	4.12	0.16	~	~	~	0.04
eu	2.22	2.08	0.14	~	~	~	3.91	3.96	-0.05	~	~	~	0.20
ec	2.42	2.21	0.21	~	~	*	4.13	4.00	0.13	~	~	~	0.08
ir	2.83	2.38	0.45	**	**	**	4.33	4.28	0.05	~	~	~	0.40
iu	2.56	2.15	0.40	**	**	**	4.54	4.30	0.24	~	~	~	0.17
ic	2.73	2.27	0.46	**	**	**	4.33	4.06	0.27	~	~	~	0.19
ar	1.48	1.38	0.09	#	~	*	1.93	1.74	0.19	~	~	~	-0.09
au	1.29	1.20	0.09	#	~	*	1.43	1.48	-0.05	~	~	~	0.14
ac	1.48	1.33	0.15	#	*	**	1.74	1.69	0.05	~	~	~	0.11
dr	2.49	2.37	0.12	#	~	~	2.98	2.76	0.22	~	~	~	-0.11
du	1.76	1.76	0.00	#	~	~	1.98	2.02	-0.04	~	~	~	0.04
dc	2.33	2.18	0.15	#	~	*	2.72	2.52	0.20	~	~	~	-0.05
s_ym	2.85	2.66	0.19	n/a	**	**	3.91	3.80	0.11		~	~	0.08
n~	*379* *55%*	*310* *45%*	*689* *100%*				*54* *52%*	*50* *48%*	*104* *100%*				

** = significant difference at 99%, * = significant difference at 95%, ~ = difference not significant. (all 2 tail),
# = Chi-squared not reported due to low cell counts

Figures

Figure 1: Box-Plot of general skills index (s_ym)

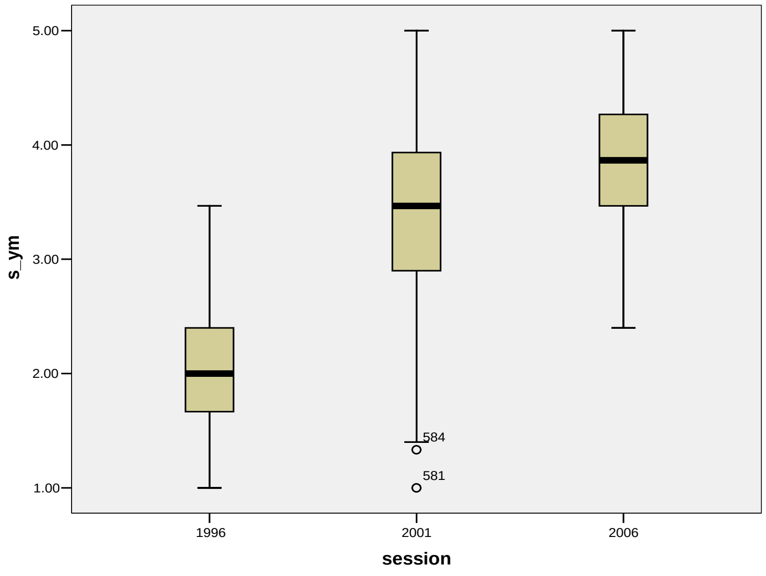


Figure 2: Box-Plot of general skills index (s_ym)

by year and cluster group

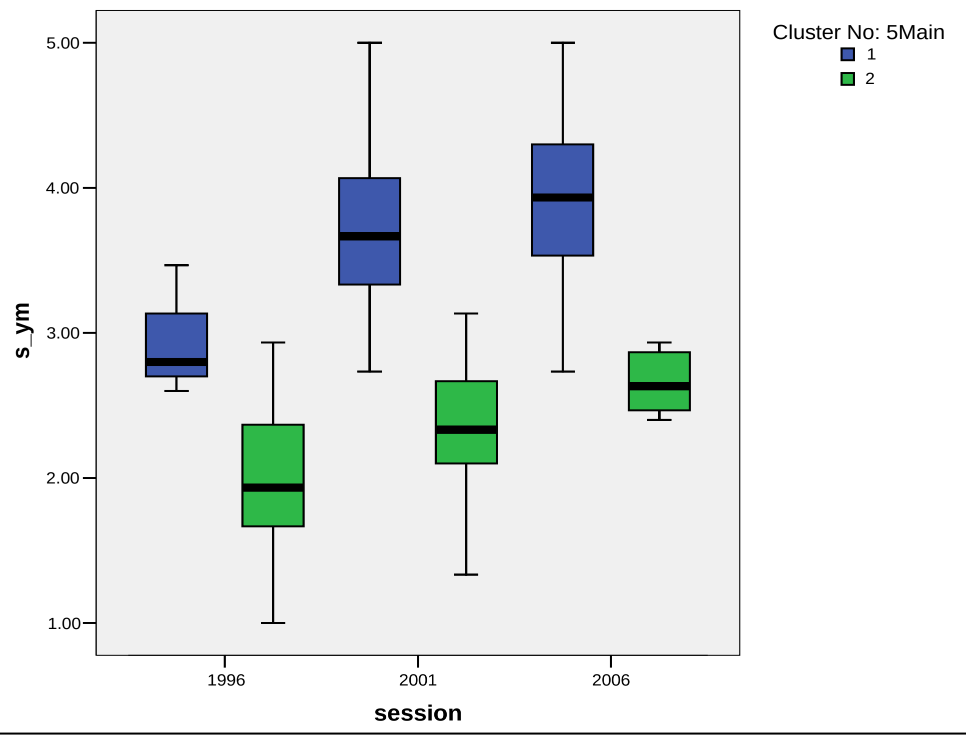


Figure 3: Distribution of IT application skills index s_ym

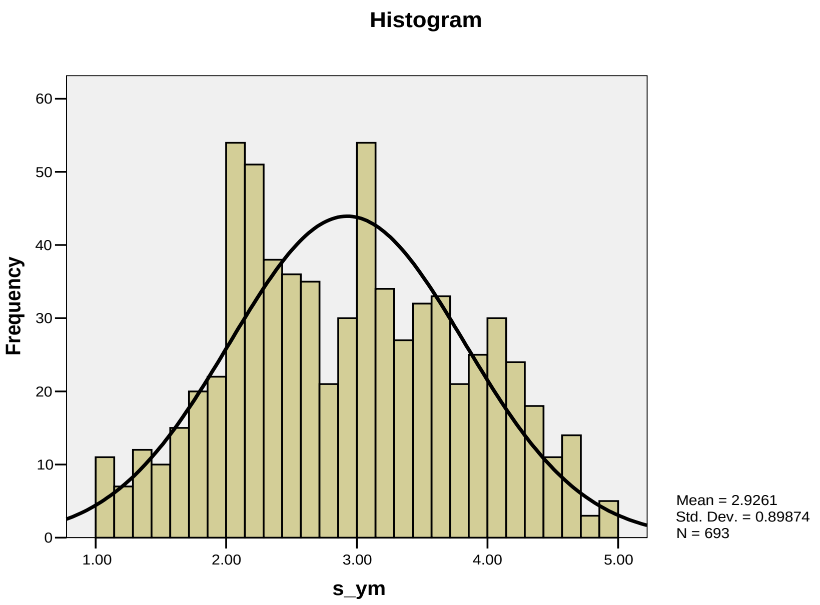
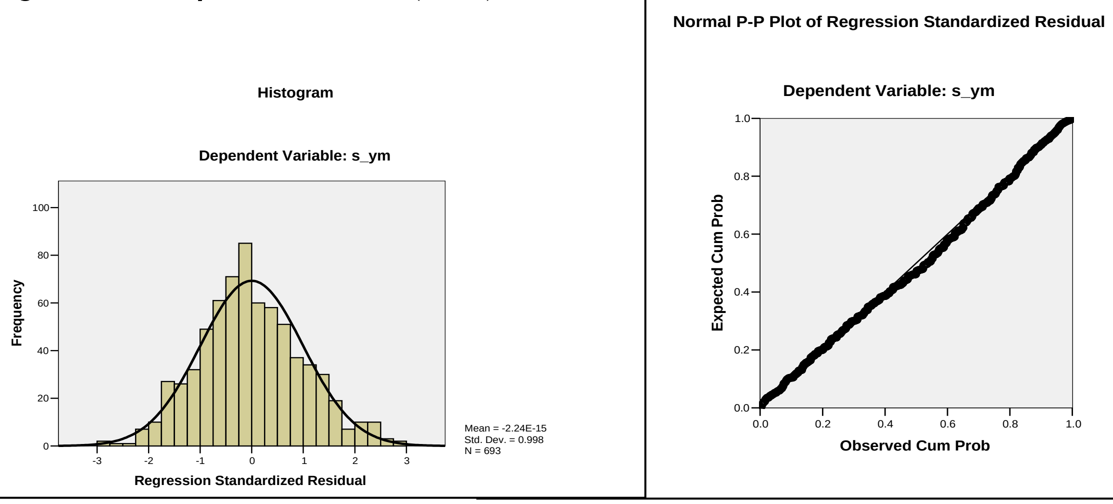


Figure 4: Plots of model residuals (a & b)



Notes

[1] Presentation software was not considered an important skill for accountants in the mid 1990s; see for example their omission from the survey of McCourt Larres and Oyelere (1999).

[2] The other three specified application areas in this section of IFAC's education guideline are 'professional research tools', 'anti-virus and other security software' and ' utility … and other relevant software' (IFAC, 2003a, p. 67). The first and last of these are ill specified but do not appear to be the types of application areas we would expect of entrants to HE. The remaining application is one that we might like to see but is not central to the effective utilisation of IT, being more to do with the security of the overall computing environment: an area often outside of students' span of control.

[3] Throughout the 10 year period the majority of entrants to the accounting degree achieved at least 5 passes in their Scottish 'Highers' from a single sitting (year), with 3 A grades and 2 B grades (including English & Mathematics), or the equivalent of 3 As and 3Bs after a second sitting. As most students take only 4 or 5 Highers at their first sitting this equates to a high standard of performance, and is, for example, roughly equivalent to grades of ABB or AAB in A-Levels, the public exams in the rest of the UK. Only 8% (1910) of all candidates for the Higher exams achieve 3 or more A grades at the 2005 sitting of the exams: source Scottish Qualifications Agency, Table NH7c , http://www.sqa.org.uk/sqa/6514.564.html (on 19/06/2007).

[4] In addition it is arguable that the analysis in McCourt Larres *et al.* (2003) fails to adequately address a technical issue which makes their conclusions on leniency suspect: the valid comparison of the scores from the objective test to the self-assessment scores. They state that by converting the scores to percentages of the maximum possible score they '… facilitate a direct comparison.' (p. 105). However, this is not necessarily the case; not least because these percentages would be highly sensitive to a number of subjective decisions on the structure of the survey instrument: for example, the number of questions set in the objective test (to illustrate; removing the six most difficult questions could raise the objective test score by up to 50% of the percentage used in the comparison). Further, the percentages calculated for the self-assessment scale appear to be artificially inflated, as the minimum score on the scale used is 1 (20%), compared with zero on the objective test (with guessing discouraged).

[5] Two additional relevant tests were used but are not reported in detail. The F-test of difference in variance (at 95%) was used to decide whether to use the pooled or unpooled data for the t-test. The Kolmogorov-Smirnov non-parametric test, which produced similar results to the Wilcoxon test, Test details are not reported as the Wilcoxon test is more appropriate for these large samples (Siegal and Castellan, 1988).

[6] A paper detailing these changes is available from the author.