

Actuaries excel: but what about their software?

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1 Introduction

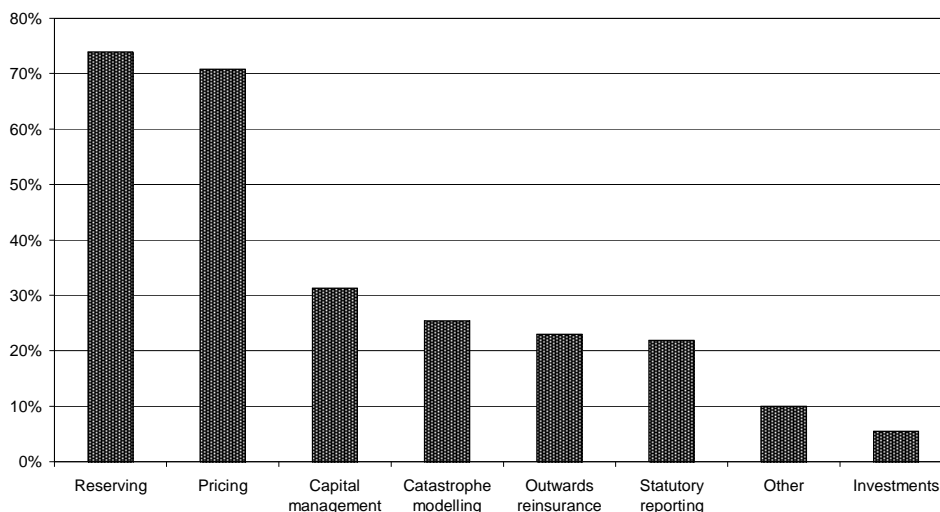
Software is a key part of our day-to-day work as actuaries. From the moment we sit down at our desks we are using e-mail, spreadsheets, databases and a host of other packages. Yet despite its importance, relatively little time is spent discussing how software is used and what problems are associated with any particular package. Our aim was to start addressing these questions.

The first step in understanding actuarial software use is to find out what software is being used. We therefore decided to conduct a survey of actuaries working in general insurance. Our request for survey participants was forwarded to their mailing lists by both the UK Actuarial Profession and the CAS. The response level was high, indicating that this is an issue of importance to many non life actuaries.

1.1 The survey

The survey was conducted online, and consisted of 33 questions (see Appendix A). The first part of the survey identified the characteristics of the respondent: type of employer, years of experience in the non-life insurance field, geographical location, area of work, and so on. Respondents were asked to specify all the areas of work in which they used software, and then to pick one area of work with reference to which they would answer the remainder of the survey. There were then sections on each of

Areas in which software is used



the following types of software:

- Spreadsheets
- Spreadsheet add-ins
- Statistical packages
- Databases
- Programming languages
- Other software

For each type of software, we asked about what packages were used, how often, and how useful they were found.

In all sections of the survey respondents were given the opportunity to add comments on any aspects of their software use. We found that these free-form comments showed some common trends, as discussed later in the paper.

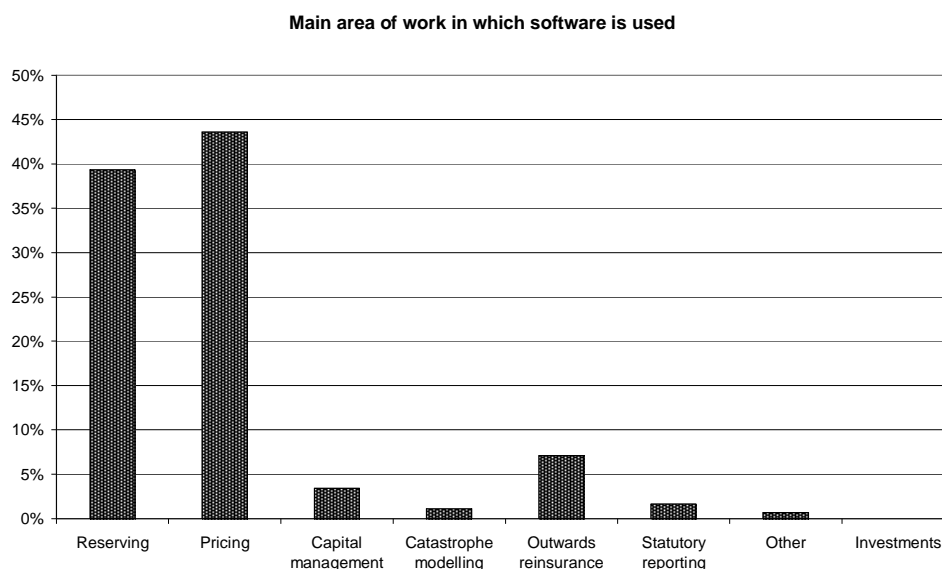
1.2 Summary of data analysis

There were 779 respondents in total. Of these, 47 were discarded because they had not provided enough information to contribute to the analysis: for example, if no main area of work was specified. We therefore analysed 732 responses.

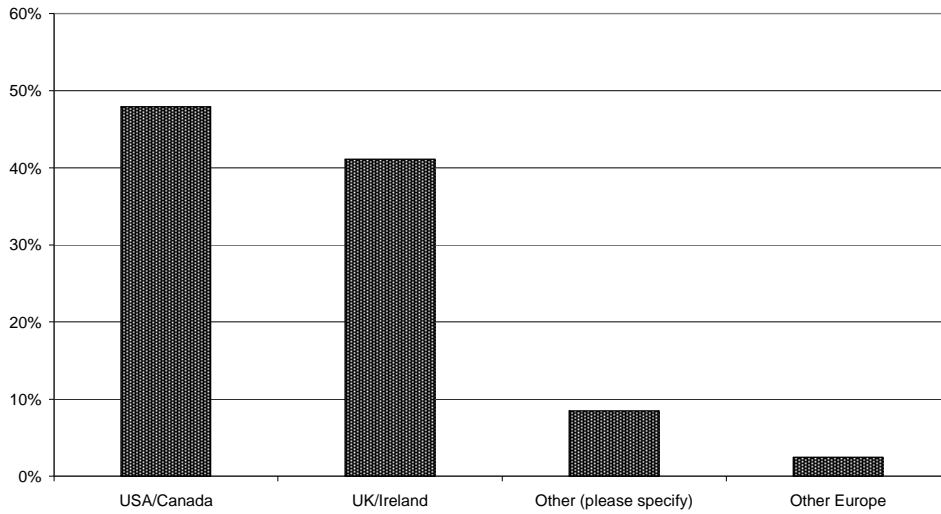
We then prepared a number of frequency tables at different levels of detail, for example to examine overall responses and those divided by geographical location, experience of the respondent, and area of work.

1.3 Summary of results

All the figures in this section are relative to the total of 732 clean responses. Pricing and reserving are by far the most common areas of work.



Respondents by geographical area



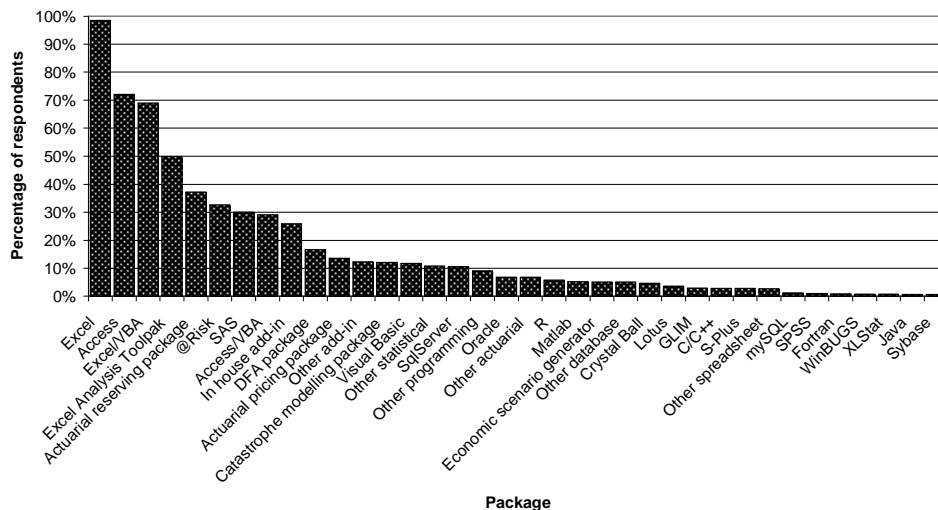
Most of the respondents reported reserving (44%) or pricing (39%) as their main area of work.

The responses were mainly from the USA/Canada or the UK/Ireland, with relatively few responses from "Other Europe" and "Other". For subsequent analysis these levels were combined into "Europe" (44%) and "Rest of the World" (56%).

Excel appears to be almost universally used, with 98% of all respondents saying they use it. In fact 100% of respondents who had been working for 0-2 years use Excel, so perhaps it won't be that long before this package reaches the 100% usage level. Microsoft also achieves an 86% usage rate for Access and the Excel Analysis ToolPak is very widely used. Of the other packages, SAS is reasonably popular, with more than a quarter of respondents. Packages produced by actuaries, for actuaries, were all well used (although by design it is not possible to identify specific packages). @Risk also rates a mention, as this Excel add-in is used by nearly a third of respondents.

There are some notable differences between responses from Europe and the rest of the

Percentage of respondents using each package



world, with European actuaries far more likely to use actuarial software and Excel add-ins. This is probably related in part to the type of work being done by the respondents. Of those who replied, actuaries in Europe are more likely to work in the areas of capital management and outwards reinsurance than their colleagues in the rest of the world. This probably reflects the influence of the FSA risk-based capital regime, and the influence of the London Market.

Looking only at European actuaries, there is some evidence that software use varies over an actuarial career, for example with the use of Excel/VBA, actuarial reserving, actuarial pricing and DFA software peaking in the 3-5 years of working category. There is no such effect in other geographical areas or with other software.

1.4 Outline

In the remainder of the paper we consider each of the main types of software in turn:

- Spreadsheets and add-ins
- Statistical packages
- Databases
- Programming languages
- Specialised actuarial software
- Other software

Finally, we present our conclusions and suggestions for further work.

2 Spreadsheets and add-ins

The first electronic spreadsheet, VisiCalc, was released in 1979. Just a quarter of a century later spreadsheets are so ubiquitous that it is difficult to imagine actuarial life without them. Since 1979 VisiCalc, Lotus 1-2-3 and Excel have in turn been the dominant players in the market. Interestingly, there are no reliable estimates of the current number of spreadsheet users, or for Excel's market share. Although spreadsheets other than Excel are available (even Google now has an online spreadsheet), they show no sign of challenging Excel's dominance; indeed, to many people the terms "Excel" and "spreadsheet" are synonymous.

There are two ways in which the functionality of Excel (or other spreadsheets) can be extended. First, the user can use a programming language included in the spreadsheet package to write their own functions. The language included in Excel is Excel/VBA (Visual Basic for Applications). Second, various add-ins are available, that provide special purpose functions that can be used in formulae or perform actions. Some widely available add-ins include

- **Excel Analysis Toolpak** is supplied as part of Excel. It provides a number of data analysis functions, including various statistical functions and random number generation.

- **@Risk** and **Crystal Ball** enable Monte Carlo simulation
- **XLStat** provides specialist statistical functions.

In addition, many of the specialist models (actuarial and other) come with Excel add-ins that facilitate interactions between Excel and the models, either for analysing the results or inputting data or parameters.

2.1 Characteristics

It is usually thought that no special skills are required to program spreadsheets, just common sense. Indeed, building a spreadsheet is not usually thought of as programming at all. This means that they can be (or at any rate are) used by people with no software training, but who are experts in other fields (such as actuaries). They enable a rapid response to changed requirements, as the people building the spreadsheets are often the same as, or work very closely with, the people using their results. There is no need to explain what is wanted to a specialist programmer, and hence less delay in implementation.

Spreadsheets are also very flexible, providing a broad range of functionality. Excel, for example, provides a simple database functionality, statistical functions, and goal-seeking iterations. Add-ins and the ability to program additional functions provide further flexibility.

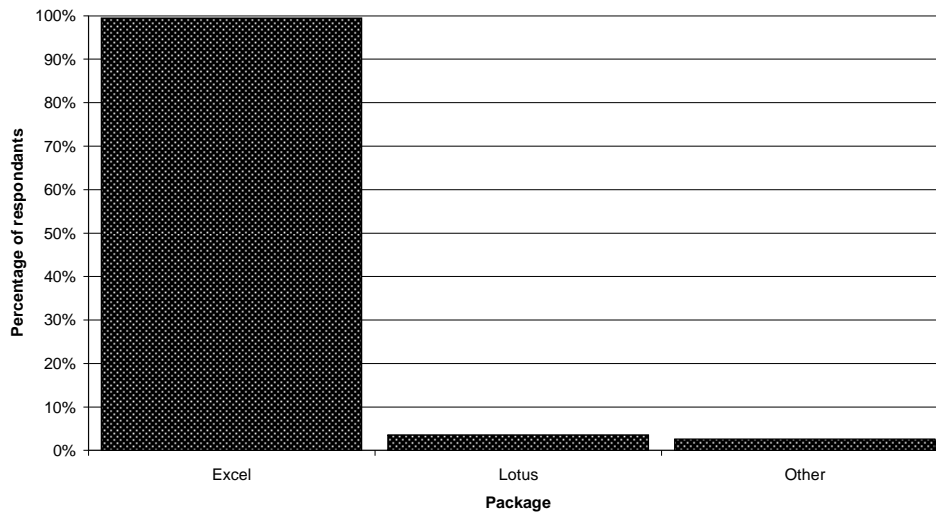
Reported error rates suggest that the confidence that is often placed in spreadsheets is misplaced. Studies consistently show error rates approaching 100% when measured by spreadsheets, or 10% when measured by unique formulae within each spreadsheet [Pryor A]. A recent study of project financing spreadsheets found errors in all 30 spreadsheets analysed, with up to 25% of unique formulae containing errors [Lawrence]. The error rates that are typically found are consistent with other data on human errors [Panko]. There is some evidence that better development practices, including rigorous code inspection, can help to reduce the number of errors.

Anecdotal evidence suggests that errors in spreadsheets can result in large monetary losses: for example, \$24m (Canadian) because of a pasting error, \$70m (US) due to a modelling error and \$1.2bn down to “an honest mistake”. [Pryor B, Eusprig].

Moreover, many spreadsheet systems are large and complex, consisting of many interconnected spreadsheets that also communicate with other software systems. They also tend to be used for mission-critical purposes. The combination of error-rates and the size and complexity of the systems suggest that more conventional software engineering processes may be appropriate than are generally used. However, the use of such processes, and the tools that generally facilitate them, are made more difficult than with systems built using more conventional programming languages by many of the characteristics of spreadsheets: the code is intermingled with the user interface and formatting information, files are stored in binary format, and so on.

Although spreadsheets are so flexible, and contain so much functionality, they can be computationally very inefficient. They are often unsuitable for use with large data sets (Excel can only handle 256 columns and 65536 rows in each worksheet).

Percentage of spreadsheet users using individual packages



The statistical functionality in Excel is limited: there are many analyses that you just can't do, without programming from scratch yourself. In addition, the analyses that are there (mostly in the Analysis Toolpak) don't use the best available algorithms, or use non-standard definitions. Distributions are not computed with sufficient precision, missing data is handled incorrectly, and there are numerous other problems [PracticalStats, McCullough, Heiser]. Some of the problems are more evident in the tails of the distributions; as much actuarial work is out in the tails, this makes the problems particularly unfortunate [Microsoft]. The random number generator is not really random enough, and in one version of Excel could produce negative numbers, as well as numbers in the [0,1] range as specified [Pryor C]

As a possible indication of the future, the Sarbanes-Oxley Act in the USA requires new audit control mechanisms for publicly traded companies. This in turn has caused many companies to question their ability to implement and maintain controls when they use Excel as part of their analysis process.

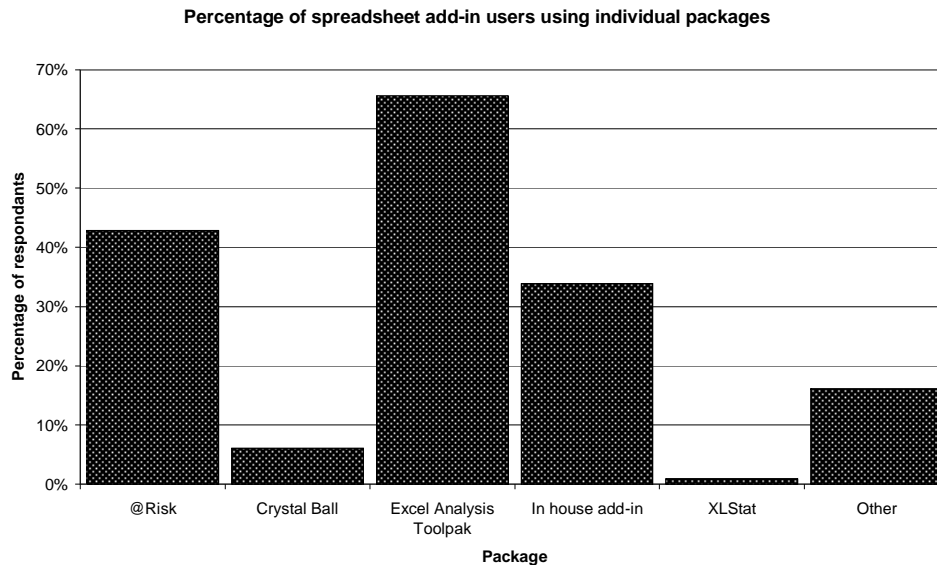
2.2 Pattern of use

As expected, spreadsheets are widely used by actuaries in non-life insurance. 99% of our respondents use them; and 99% of those use Excel. The next most common spreadsheet was Lotus, with 4% of those using spreadsheets. This high rate of spreadsheet usage is consistent with findings from other areas of business life [Baker]

There are few differences by area of work, type of employer, geographical area or experience level. However, only 90% of those working in reserving class Excel as "Vital", compared to 98% in pricing and 100% in all other areas.

Excel is also used very frequently (95% use it daily) and is considered very important to the users (90% consider it vital).

76% of users use at least one spreadsheet add-in. The most popular is the Excel Analysis Toolpak, with 66% of respondents using it. This is probably an



underestimate, as some people may not realise that it is not part of the core Excel functionality. It is used in all areas of work.

43% of respondents use @Risk, and another 6% use Crystal Ball. They are used in all areas of work, with fewer people using them for statutory reporting. However, they are considered vitally important more often by those working in capital management, and are used daily by a higher proportion of those working in catastrophe modelling.

Only 1% of respondents use XLStat. 34% use in-house add-ins, and 16% use other add-ins (mostly those supplied as part of specialist models).

2.3 Comments

There were three main views expressed about Excel in the comments: it's absolutely wonderful, it's computationally limited, and it's difficult to control. Many of the comments combined two of these views:

- Quick and easy to use, but tricky to check and to understand when it's not yours.
- The greatest advantage of spreadsheets is their greatest weakness - flexibility. To be a safe user of spreadsheets you need to understand them; be logical and clear thinking; but also fussy, and neat and tidy, with good attention to detail.
- Easy to visualise data, very poor at handling large data volumes
- I use spreadsheets for EVERYTHING. I strongly favour a greater emphasis on good spreadsheet usage at all levels.
- Nearly universally used -- easy to share around the firm and with clients. There are bugs and incorrect calculations that can surprise one (problems with the gamma probability distribution to name one).
- Excel is very flexible, but difficult to control and document

The computational limitations were recognised by a number of respondents. A common theme was the difficulty of handling run-off triangles.

- Spreadsheets are poor at handling run-off triangles
- Excel has the drawback that there is no function to view the diagonal of a loss development triangle as a column (like there is with reserving software).

The limited size of data sets was another common gripe.

- A big drawback with Excel is its performance and limited data handling capabilities
- Excel memory management is inadequate, so it's very easy to build a Monte Carlo model which is too big.
- Problems with manipulating/saving larger files
- Limited capacity, sometimes crashes with large amounts of data.
- Our models are pushing the limits of Excel as we expand what we are including and the number of scenarios simulated. It is likely that we will make a change in the near future.
- Excel is inefficient and a resource drain. Large spreadsheets bomb, run slowly, etc.
- Excel doesn't allow large enough lists of data files to be imported.
- Due to the volume of data I have to manipulate I frequently have problems with Excel being unable to cope and struggling to re-calculate or refresh. Also many issues with linking of spreadsheets. Frequent problems where figures are not refreshed properly or revert back to previous versions of files. Often, the only way to be sure everything is feeding through properly is to open every single file in chain. Due to the size of the files we are using, this creates problems in itself.
- Limited data capability, i.e. data sets can exceed the number of rows or columns of Excel - in that case use aggregated data or get someone to summarise for me using SAS!

Some people were very aware of the limited statistical functionality.

- Can be slow to do some tasks Some statistical functions are unreliable
- My systems have lots of add-ins and VBA so there are few drawbacks The major one is distribution fitting where the Excel functions give incorrect answers There are lots of traps for the unwary (and wary) within many Excel functions and hence the need for diagnostics

Others seemed rather less aware.

- @Risk is useful for the standard probability distributions, but where the distribution is derived from data, Monte Carlo simulation using rand() function in Excel is quicker.

Many respondents commented on the difficulty of enforcing adequate systems and controls around spreadsheets.

- Definitely need better version control within Excel (e.g. ability to track changes, comparison between versions etc.)
- Each spreadsheet stands on its own and changes to one spreadsheet must be made to all similar spreadsheets

- Biggest drawback is the ease with which an inexperienced person can do something that looks reasonable, but which lacks integrity. Requires massive amounts of checking.
- Spreadsheets speed things up, especially when one can link together sheets, introduce extra analyses, use macros, etc. But this encourages even greater speed and that is counter to (a) proper checking and (b) proper documentation. It's tempting to think that a formula driven spreadsheet can be easily followed by anyone with an ounce of intelligence, ignoring the fact that it is hard for anyone faced with 67 worksheets to know where to start, particularly as it then becomes apparent that half of them are redundant and have not been updated from last year!!!
- Almost impossible to set-up with a good solid control-mechanism for Sarbanes Oxley purposes Very useful for ad hoc tasks
- Definitely need better version control within Excel (e.g. ability to track changes, comparison between versions etc.)
- It is difficult to monitor changes with a spreadsheet. For instance, an actuary might use a particular spreadsheet model. If there is a one-off change in a calculation, or a mistake, that error could be perpetuated going forward very easily.
- Excel pivot tables and automatic filtering feature prominently in the analyses that we produce and use. Excel is limited to ~65K records. Excel can use MS Access as the source of pivot table data, but this also has limits.

A number of people commented that they use Excel primarily as a front end to other systems.

- I receive most data from outside sources as Excel spreadsheets, but I use Excel mainly as a way of loading the data into my own APL-based system, and occasionally as a way of communicating output from that system.
- I occasionally use Excel to transmit information to others, but I don't use it for reserving work as such.
- I use very few Excel built-in: it is more a useful windowing system onto my own VB code than anything else. I trust it to multiply, but not much else.

Several people felt that spreadsheets don't serve the profession well

- I feel that a profession, we have become too dependent on spreadsheets. While they help expedite workflow, they tend to lessen the application of judgment, sound reasoning and analytical skills!
- Actuaries use spreadsheets too much. They are useful for small calculations, testing etc but for more complicated calculations one ought to use a proper programming environment.
- Some people just love Excel. Pivot tables are especially popular.
- Excel is fantastic.
- Excel is so powerful that other software is used less and less. Use it for all sorts of workings, mostly fairly simple, and for self-documenting of work.

- VBA component, linkage to Word & VB is what makes excel so good
- Excel's greatest strength is its flexibility
- Very flexible for setting up models. Can do complicated things with VBA e.g. simulation. Everybody in the company can use Excel to some extent so easy to train underwriters to use models and rating spreadsheets. When I used to do reserving we did all our work in excel spreadsheets as it was possible to set them up to deal efficiently with the data that we received rather than wasting time formatting data for other packages or getting results out of packages and formatting them to input into spreadsheets for reporting.
- I really love Excel that provides all the options we need to do day-to-day work including formulas, pivot tables, charts, etc.
- pivot capability is key

2.4 Discussion

Excel is clearly both ubiquitous and popular. However, there may well be a significant proportion of actuarial users who are not aware of its limitations as far as statistical functions and random numbers are concerned. This is worrying, as Excel is extensively used for statistical analysis. Many of the users are worried about the difficulties of controlling spreadsheets, and run into problems when they are handling large data sets. Excel is often seen as a universal tool, suitable for more or less any purpose, instead of the swiss army knife it more closely resembles. It is possible to do most analyses using Excel, but there are often more suitable tools available.

3 Statistical packages

A statistical package is a suite of computer programs that are specialised for statistical analysis. It enables people to obtain the results of standard statistical procedures and statistical significance tests, without requiring low-level numerical programming. Statistical packages are intended to save time in programming to allow the user to focus on understanding the results.

They have a variety of functionality including the available range of statistical functions, different user-interfaces ranging from point and click to programming, most include facilities for data management and different links to other software such as Microsoft products.

Some of the main statistical packages in use in general insurance are SAS, R, MATLAB, GLIM and S-Plus.

3.1 Characteristics

3.1.1 SAS

The SAS website says "... SAS provides a complete, comprehensive and integrated platform for data analysis. ...With SAS, you can easily access data from any source,

perform data management, carry out statistical analysis and then present your findings in a variety of reports and graphs.” [SAS]

SAS can perform a variety of statistical analyses including analysis of variance, regression, categorical data analysis, multivariate analysis, survival analysis, psychometric analysis, cluster analysis, and nonparametric analysis. It can handle large databases and many applications can be handled using point and click although user-written functions can also be used (and may be required with large datasets). See section 5.1 for further discussion.

SAS has a high level of integration with other packages and can be used for graphical output. It can have a steep learning curve, which may be an issue for intermittent users. The programming language is not always intuitive. It is well-supported but can be expensive.

3.1.2 R and S-Plus

R is an open source project based on S-Plus. It is described as “a language and environment for statistical computing and graphics...R provides a wide variety of statistical (linear and nonlinear modelling, classical statistical tests, time-series analysis, classification, clustering,...) and graphical techniques, and is highly extensible.” [R]

Both R and S-Plus are interactive programming languages, which can make them difficult to learn for those with no programming experience.

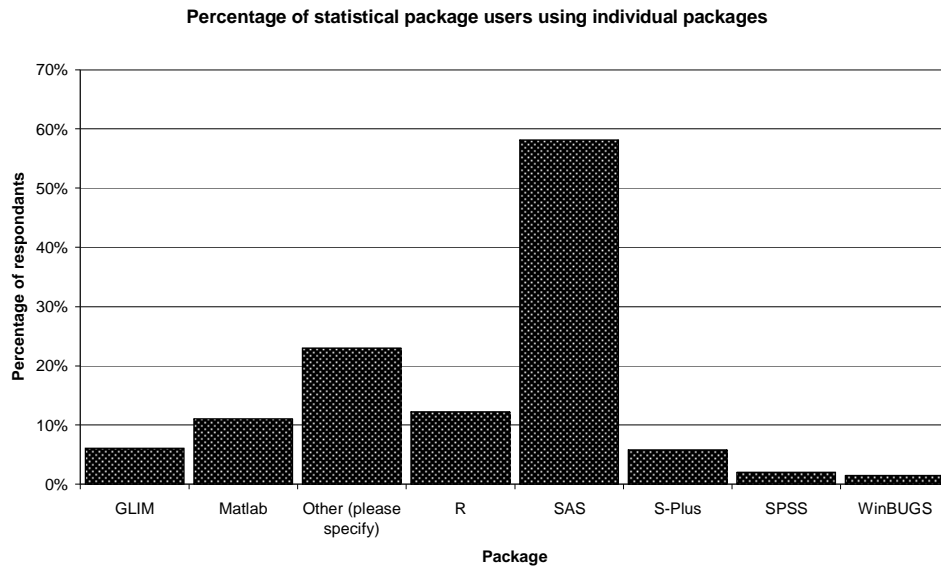
R interfaces well with other software and is widely available. It works on many platforms and is free. It requires large amounts of memory for large datasets, which can be a problem. The help system is not always as useful as those of commercially available software. It is by far the most common package used by statisticians in universities [Orr].

3.1.3 MATLAB

MATLAB is a commercially available statistical package. Its features include mathematical functions for statistics, 2-D and 3-D graphing functions and functions for integration with external applications including Excel. Like R and S-Plus, it provides an interactive development environment. [Matlab]

3.1.4 GLIM

GLIM is a purpose-built software package for fitting generalised linear models. It can store macros for frequently-run analyses but it has few bells and whistles as it is built by statisticians for use by statisticians. It is not a general purpose statistical package so the user must have a good understanding of generalised linear models. GLIM development has ceased and it is no longer supported [GLIM].

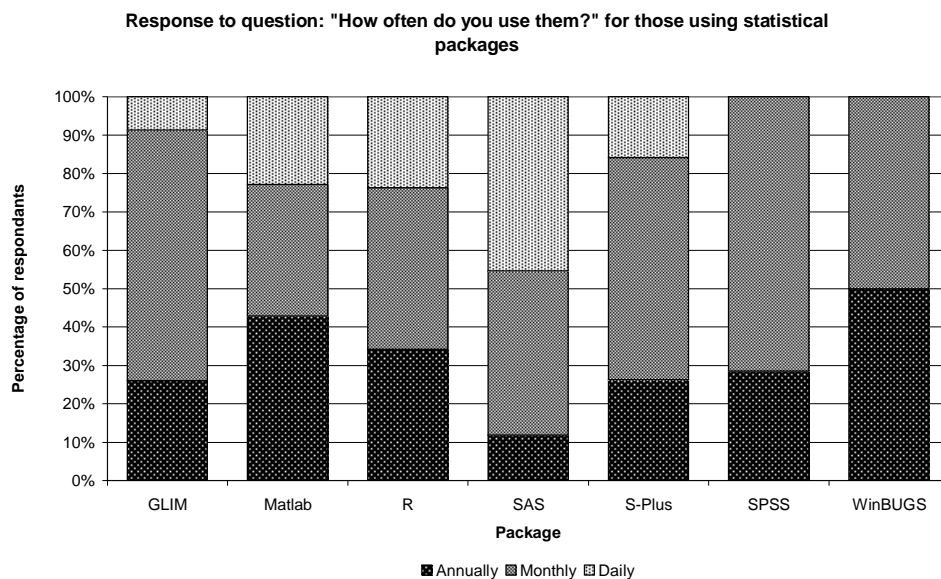


3.2 Pattern of Use

Statistical packages were used by 47% of respondents to the survey. Of these, the most commonly used package is SAS, although reading the comments from the survey, it seems that it may be used more as a data management tool than for its statistical functionality. The other common packages are R, Matlab, GLIM and S-Plus.

‘Other’ included:

- Actuarial-software packages
- Other statistical packages such as Minitab (3 responses), Mathematica and Statistica (3 responses each)
- 6 respondents used in-house statistical software
- 1 used an Access add-in called “Total Access Statistics”



SAS is used more frequently by its users than the other statistical packages. This is probably because of its data management capabilities.

Non life actuaries in the US and the rest of the world are a little more likely to use SAS while their UK/Ireland and Other Europe colleagues are slightly more likely to use specialised actuarial software for their statistical needs. (Most “Other” responses mentioned specific actuarial software.)

3.3 Comments

3.3.1 SAS

SAS is valued for making it easy to work with large datasets but is perceived as having a steep learning curve. Many users don't actually use the statistical functionality.

- For data manipulation (particularly with large datasets) I have found no peer to SAS. End-users create their own tables without any assistance from DBA's; no size limit other than DASD, tables can be easily modified or rebuilt. This is much more flexible than Oracle/SQL if your needs are continually changing.
- Learning curve for SAS is steeper than for other software packages
- Though I regularly use SAS, it is in more of a data filtering/manipulation role. I've never used the statistical functions.
- I use SAS primarily for data retrieval from the mainframe. I don't really use the statistical capabilities of SAS.
- More useful than Excel for certain jobs because you aren't limited by the number of columns in Excel. Problem is that it is technical and involves programming which isn't familiar to most people- Excel is used in school, university and most offices so people know the basics of it without training.
- ...but SAS as a data warehousing tool, not a statistical system
- SAS is critical for data mining / predictive modelling. Useful for large data projects
- SAS is the package that underlies our generalised linear modelling software package
- Due to volume issues, we still use mainframe processing for a good portion of the analysis that we produce. We use mainframe SAS, not PC SAS. However, most of the SAS use is not for the sophisticated modelling procs, but simple data manipulation, sorting, summing and report production, due to its ease of use.

3.3.2 R and S-Plus

The graphical capabilities of R are highly valued but it seems its full potential is not currently being utilised.

- Use R in conjunction with Latex—to produce automated reports. At the moment R is mainly used for its graphical capabilities—hope to introduce more statistics in due course!

- Excellent graphics and data visualisation. Fast for Monte Carlo simulation, though need to be careful with loops. Poor user interfaces puts off some potential users. However these products are best used via their programming interface.
- "R" documentation is not great
- Real answer is somewhere between useful and waste of time i.e. not useful YET. R looks very powerful for analysing statistics, but runs in RAM (or seems to) so not enough memory for large (10,000 simulations) dataset
- It's free with comprehensive functions and quality graphics capability.
- Primary, we use SAS on the mainframe environment. R's work space is limited by RAM, which is a significant draw back to us with significant amount of data.

3.4 Discussion

Statistical packages are mainly used by pricing actuaries and in catastrophe modelling and capital management. However, they do have application to other areas. Of the available statistical packages, SAS is by far the most used, the one considered most vital and the one used most frequently. It appears to be valued for its ability to handle large datasets as much as, if not more than, for its statistical capability. Many people, particularly in Europe, use specialised actuarial software for statistical analysis but R is also a popular choice. R appears to have the potential to become a much more important piece of software, if data size limitations can be overcome.

4 Databases

A database is a large, organised collection of information that is accessed via software [Pressman]. The technology is widely applicable, and is used to store and access datasets of widely differing sizes containing many different types of information. Many websites are built on top of databases, for example, and blogs and wikis rely heavily on them. Claims and policy administration systems make heavy use of databases.

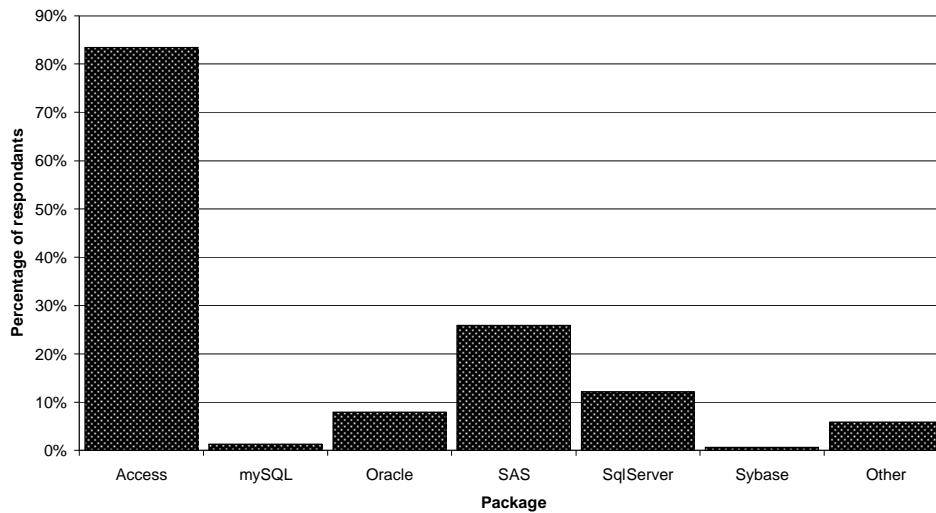
4.1 Characteristics

Most modern databases are relational: the data is stored in a number of different tables, connected by common fields. For example, the data in a claims table would include the policy number, thus enabling the relevant policy information to be accessed. Relational databases, when designed effectively, allow each piece of information to be stored only once.

Other database structures include:

- Flat. There is effectively a single two dimensional table. Each piece of information is stored as many times as it is needed. A spreadsheet can be used as a simple flat database.
- Hierarchical. The data is organised in a tree like structure. This was more popular in early mainframe systems.

Percentage of database users using individual packages



- Network. The data is organised into records and sets. Records contain the fields and the sets define relationships between records.

Databases can typically handle much larger volumes of data than spreadsheets. Relational databases provide great flexibility in retrieving data, through the use of SQL (structured query language). Databases can also be used for many different types of information, including images as well as numeric and text data.

Access is part of Microsoft's Office suite. It is a single user relational database, with a graphical user interface. It can handle only small datasets (for a database). It is not used for mainstream administrative tasks, which need to be able to handle large datasets and many users.

SQLServer is Microsoft's multi-user relational database. It can be used for enterprise applications. Other enterprise level databases include **mySQL**, and **Oracle**. mySQL is open source, and is free to use, although support packages are not free. It is widely used for web sites. Enterprise level databases offer much more sophisticated functionality than a single-user database such as Access, but are more difficult for the casual user.

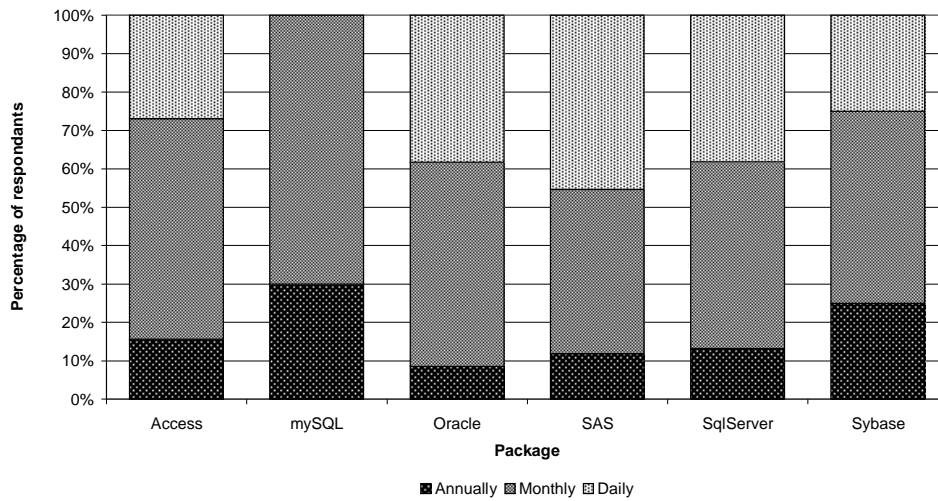
SAS, a statistical package discussed in section 3.1, is often used as a flat database.

4.2 Patterns of use

Databases are used by 86% of the respondents.

Microsoft Access is the most widely used package, with 83% of those using databases using Access. This may be because it is widely available to many users as part of the MS Office package. However, a variety of other packages are also used, with SAS, SqlServer and Oracle being the most popular.

Response to question: "How often do you use them?" for those using each database package

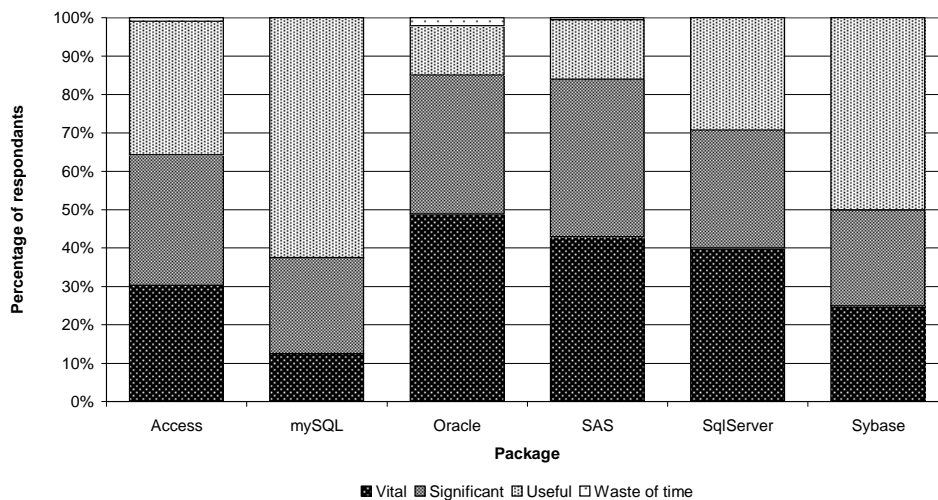


Databases are generally used on a monthly basis, so unlike spreadsheets they are not seen as part of the day to day armoury of most actuaries. They tend to be used for one off analyses and less frequent manipulation and analyses of large datasets. With many actuaries only using databases infrequently it's hard to fully develop the skills to use them effectively.

Of those using databases most found them of vital or significant importance. However, there was also a substantial number of people commenting that databases were "useful" for their work. In particular, the majority of people using MySQL noted that it was useful, rather than vital or significant. Geographically, we found no statistical differences in the use of databases.

One interesting statistic concerns what other software the people use. The responses suggest that where people use Access, they are not very likely to use other database software, i.e. they are happy with what they are using. The converse is also true, so people using other database packages do not tend to use Access.

Responses to question: "How important are they in what you do?" for users of each database package



4.3 Comments

Unsurprisingly the majority of specific comments concerned Access.

Some users said that the main reason they used Access was because it was used elsewhere in the organisation, so it made sense to stick to this standard.

- Access is used because other employees do not have SAS

Comments were mixed about whether Access was easy to use, these included:

- Access is not user friendly and difficult to learn
- Access's main attribute is that it is easy to use and the interface makes it easy to use - particularly for teaching others'
- Access is easier to start because it does not require much SQL code knowledge but it is slow and limited.
- Again, near-universal use makes databases portable. Reasonably easy to work with, once you get the hang of it.
- Access's main attribute is that it is easy to use and the interface makes it easy to use - particularly for teaching others. The main drawbacks are related to stability after the database gets to a certain size. I also find the upload and downloads between ACCESS and Excel don't always work perfectly (particularly if an ACCESS data field is 'text', but the contents are a mix of numbers/alpha - Excel will sometimes treat the field as a numeric field, creating mismatch if the data is uploaded back to ACCESS).

Whilst one of the main reasons for using a database is the ability to handle large datasets, some pointed out that for Access was unable to cope with very large volumes (Access has a data limit of 2 gigabytes). Therefore people commented that it was not suitable for all tasks, e.g. large capital models.

- Data storage space is not optimal so we are thinking of moving to warehouse and use Oracle or MySQL
- Access is pretty useful for database type work. Main hassles in capital modelling are the 2 gig file size limit, which is surprisingly easy to break. Also not sure how efficient it is on large datasets. Probably best way to work is have SQLserver backend and use Access for query design, then use SQL passthrough to let server do the sorting/calculations, but takes time and resource to setup and maintain

Another drawback of Access is that it is not suitable for use by large numbers of users, for example as a corporate database.

- Access is our corporate standard and that is why I use it. I am generally able to get what I need out of Access, but it seems to have too many quirks in its behavior and it seems to be lacking in the kind of security that a corporate database system should have.

Many liked the VBA programming functionality and how Access interfaces with Excel.

- Most useful in conjunction with Excel by interfacing the two products with VBA.
- Programmability is vital. Building Access applications in VBA is very quick & easy.

4.4 Discussion

Access is the mostly commonly used database package, probably due to its relative user friendliness and its availability as part of the MS office package.

However, many users are using other packages such as SAS, which is presumably popular due to its ability to handle complex functions, or SQLserver, which users view as better for larger data sets.

5 Programming languages

Nearly all actuaries in general insurance around the world use proprietary software packages as part of their daily actuarial routines. Many, we suspected, enhanced the functionality of these standard tools with programmed add-ins or macros. As part of our survey, we sought to find out which programming languages were the most popular.

On a note of caution, while checking and confirming the output of data analysis is often complex (especially if the creator fails to leave adequate audit trails), the problem is exacerbated when the calculation process is upgraded with additional programmed modules. These generally do not come with the standard checking tools. Care must be taken.

5.1 Characteristics

The software available to our profession was written neither by, nor expressly for, actuaries. Software by its very nature will perform a range of operations for which it has been designed. But frequently, for specific tasks for which actuaries use these tools, enhancements are needed. This is often achieved by increasing the software's functionality through programmed add-ins or macros, which can be contained within a particular software application, or within a library available to all the user's like applications or available more globally. The languages behind these components may vary, but by far the most common is VBA (visual basic for applications) which is available for Microsoft's software tools. Specific characteristics for some of the more popular languages used in conjunction with software by actuaries are listed below.

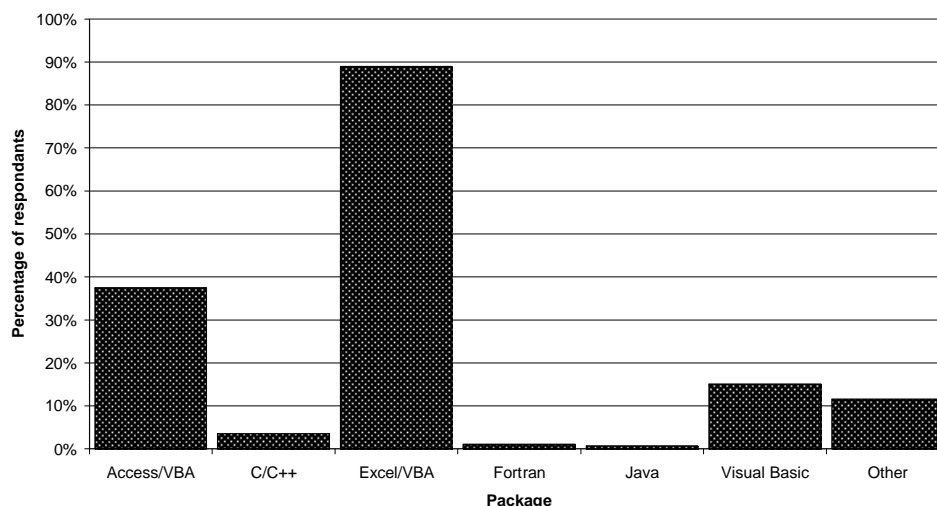
Visual Basic for Applications (VBA) is an implementation of Microsoft's Visual Basic which is built into all the main Microsoft Office applications. VBA is closely related to Visual Basic, but can normally only run code from within a host application rather than as a standalone application. It can however be used to control one application from another (for example automatically creating a Word report from Excel data). VBA is functionally rich and extremely flexible but it does have some important limitations, including limited support for callback functions. It has the ability to use (but not create) (ActiveX/COM) DLL's and later versions add support for class modules.

SAS has already been mentioned as both a database and a statistical package. SAS have developed their own programming language aimed at allowing users to update their data. This now includes all the main functionality you would expect from a basic programming language, with conditional statements and a variety of loops, as well as all the common mathematical and logical functions. SAS can actually be considered to have several related programming languages, the main one aimed at updating and analysing the data, a macro language which can be used to write SAS code at run time and an application building environment (SAS/AF) which can be used to build entire applications which sit on top of SAS.

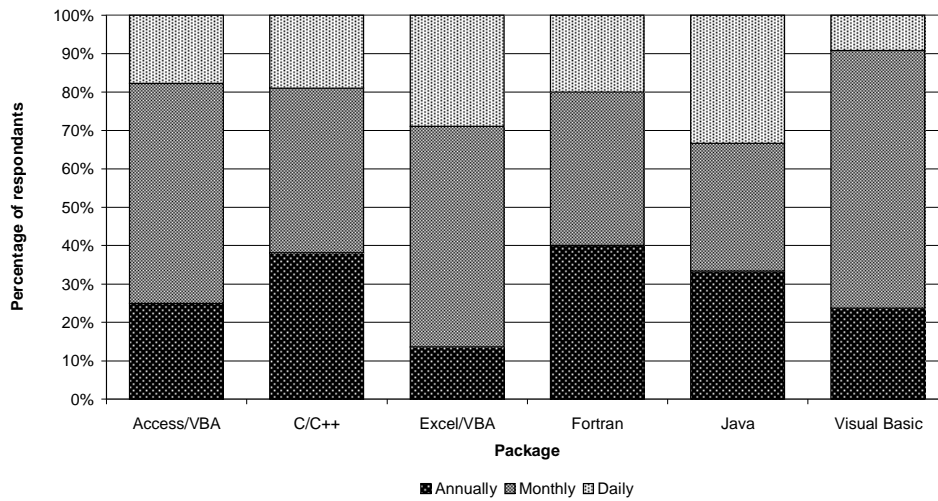
APL (for A Programming Language) is an array programming language based on a notation invented in 1957 by Kenneth E. Iverson while at Harvard University. As with all programming languages that have had several decades of continual use, APL has changed significantly from the notation described by Iverson in his book. One thing that has remained constant is that APL is interpretive and interactive, features much appreciated by its users. Conversely, its initial lack of support for both structured and modular programming has been solved by all the modern APL incarnations. One much criticized aspect of APL is the use of a special character set (see Character set below.) These characters have all been incorporated into Unicode, which is now the base character set of several APL products. Iverson later reworked APL into a language called J which not only greatly increases expressive power but also uses pure ASCII instead of a special character set.

The **C** programming language (often, just "C") is a general-purpose, procedural, imperative computer programming language developed in the early 1970s by Dennis Ritchie for use on the UNIX operating system. C is a relatively minimalistic programming language. Among its design goals were that it could be compiled in a straightforward manner using a relatively simple compiler, provide low-level access to memory, generate only a few machine language instructions for each of its core language elements, and not require extensive run-time support. As a result, it is possible to write C code at a low level of abstraction analogous to assembly language; in fact C is sometimes referred to (and not always pejoratively) as "high-level assembly" or "portable assembly."

Percentage of programming language users using individual packages



Response to question: "How often do you use them?" for those using each programming language



5.2 Pattern of use

Over 700 replied to the section on programming languages.

Of these over 72% used VBA in an Excel environment as their “language” and 30% used VBA with Access. 12% used Visual Basic on a standalone basis.

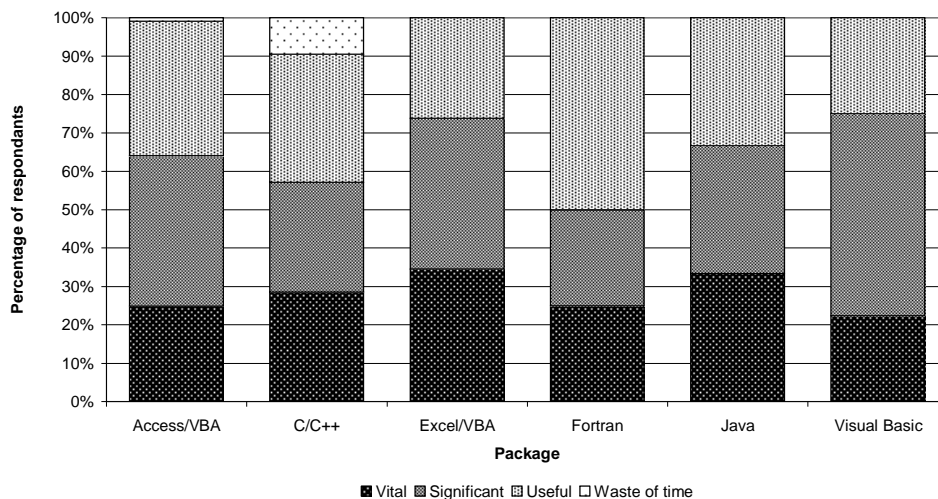
Interestingly, nearly a quarter of respondents (23%) used no languages at all.

Of other programming languages suggested by contributors, the most popular were SAS, APL and C/C++.

When asked how often these languages were used, the most common reply was monthly, for all languages, although nearly 30% of the Excel/VBA users programmed daily.

In response to the question of the language’s importance to the actuary’s work, VBA

Responses to question: "How important are they in what you do?" for users of each programming language



usage was roughly equally spread between significant, vital and useful, with the first of these being marginally the most popular answer.

The above percentages (72%, 30% and 23%) varied little when we compared the major subcategories of respondents: company vs consultant, pricing vs reserving, USA/Canada vs UK/Ireland, commercial vs personal lines, primary vs reinsurer.

Perhaps not surprisingly, only 6% of students indicated that they used no languages, while nearly 30% of people who had been practitioners for at least 11 years did not use languages.

5.3 Comments

A number of other comments were posted on language usage. A number expressed disquiet with VBA (difficult to learn slow, not intuitive, quirky, too involved); two mentioned Excel's inferiority to Lotus in the context of programming and macros. However a few liked the ability of VBA and the Microsoft environment to record macros and its facility with loops and arrays. One or two used the comments section to praise the functionality of APL and C/C++.

Comments on VBA varied from high praise to criticism to "if only":

- VB is very useful 'glue' for bolting spreadsheets together or running some tasks in Access - e.g. re-running/creating similar queries with slightly different settings.
- VBA mainly used to automate processes in rating models used by underwriters, plus to do some calculations using loops and arrays rather than doing them on the spreadsheet itself (eg Panjer Recursion)
- Important for automating processes to save time and for doing complicated calculations and simulations. Use VBA because it fits in to excel and access which are used for most work.
- Macros in Excel are invaluable in saving time, making spreadsheets more memory efficient and leaving an audit trail
- 'Help' screens provided for VBA rarely provide any useful information
- As I don't use VBA that much it's quite difficult to keep up to speed with VBA. I probably should use it more!
- VBA is not very intuitive
- VBA can be slow
- Macros are easier to write in Lotus than in VBA. They are intuitive and can be readily recorded from key-stroke actions. This is rarely the case with Visual Basic/VBA.
- Would use VBA more often except it is difficult to learn
- Took VBA programming and rarely use it. What I really want is a simple shortcut, such as the type in the old Lotus macros. They just recorded keystrokes. Simple, straightforward, used them all the time. VBA killed that. Yes, much more powerful, but quirky and way too involved for most everyday use. Too clever, by half?

There are still advocates of APL around:

- I know, old school, but very compact in coding—can get a lot done quickly and with windows versions getting data between APL and Excel not difficult.
- APL is very powerful and, for those things for which I use it, it is much faster than building a spreadsheet or modifying a template. It allows me to thoroughly debug calculations and is far less error-prone than a spreadsheet.
- For the very customized situation that I work with, APL2 is a very powerful product. But the application that I use was something that I built from scratch over time, and would be a significant amount of work to give to another person.
- APL for windows. Advantages include ability to analyze multi-dimensional information. Can be made much more secure than APL. Easy interface with Excel. Biggest downside is having to train new staff
- For reserving per se, and related analysis of loss experience, I have written my own package in APL. For ad hoc jobs, I use APL directly, from the APL command line.

5.4 Discussion

It was perhaps not surprising that when nearly 100% of actuaries surveyed use Excel and when Access is clearly the second most popular software tool, that the programming language of widest usage is VBA, from the Microsoft stable of products. Its pattern of use varied little across continents, across age groups, across company departments and across products. Other languages barely registered a pulse, though older actuaries may glean comfort that Fortran and APL still have their fans.

6 Specialised actuarial software

Specialised actuarial packages were used less often the other main software packages, reflecting the potential to use other packages to carry out the same tasks. Their specialised nature also means that the number of packages is small.

A number of respondents noted that the specialised nature of the packages meant that they were (relatively) inflexible, which can be beneficial for auditing purposes, but is less of an advantage when it comes to actually using them.

6.1.1 Actuarial pricing package

Actuarial pricing packages come in two main forms. The first is personal lines rating software that typically takes hundreds of thousands of records and fits various multivariate models. The second type of package is for commercial pricing, where there is much less data and the products are more complicated.

Some respondents noted that they rely on their pricing packages to maintain, and incorporate, benchmarks as an input to their pricing process.

6.1.2 Actuarial reserving package

Actuarial reserving packages are used for a number of different functions. Some take individual claims information to produce triangulations, others apply a multitude of different projection methods to a set of claims data to generate a number of different reserve amounts. The most advanced actuarial reserving packages provide the functionality to produce distributions as well as central estimates.

6.1.3 Catastrophe modelling package

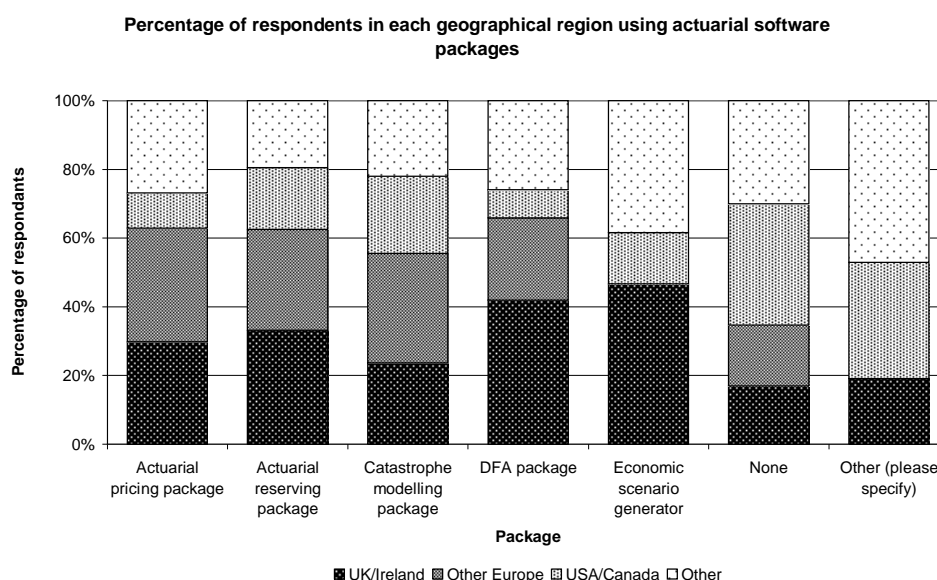
Catastrophe models have been around for a while now, but there has been a large increase in their use in insurance companies recently. This has been driven by a number of factors, including their use in setting capital requirements, their use for pricing inwards reinsurance business, and their use in assessing claim aggregations for risk management purposes.

6.1.4 DFA package

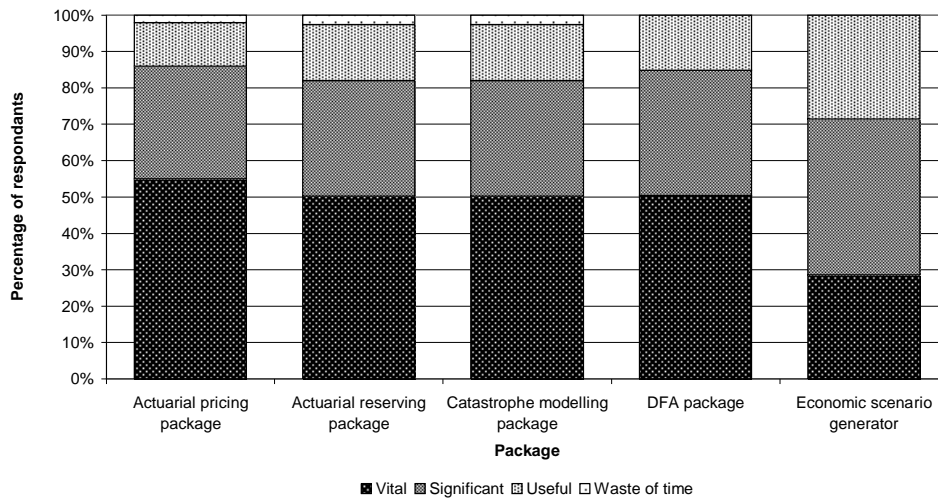
Dynamic Financial Analysis (DFA) packages have become much more prevalent during the past few years, driven by a mixture of increased processing power to carry out large Monte Carlo simulation models, and an increased focus by insurance companies on capital adequacy and risk management. DFA packages range from the very complicated (akin to a programming language) to the easy-to-use Excel based packages.

6.1.5 Economic scenario generator

Alongside the increased use of DFAs, there has been a need for better investment models, and economic scenario generators (ESGs) have been central to their development. An ESG model provides a consistent set of economic variables, such as inflation, currency exchange rates and interest rates. Based on these variables, the returns from different investments can be simulated using Monte Carlo simulation



Response to question: "How important are they in what you do?" for those using specialised software packages



methods. There is a range of ESGs available to non-life actuaries, from the simple (e.g. Wilkie model) to ESGs that are market consistent in almost every imaginable way. The SOA and CAS jointly sponsored a research project to create an economic scenario generator that is now publicly available [SOA].

6.2 Pattern of use

For most specialised actuarial software packages, there was a marked difference between UK/Europe and USA/Canada, with respondents in the former being up to three times as likely to use the packages as those in the latter. The largest difference was seen for DFA packages. This is probably mainly due to differing regulatory requirements. For instance, in the UK there is a requirement to carry out capital assessments, so the use of DFAs is more prevalent. However, this does not really explain why the split occurs for the pricing and reserving packages. Interestingly, the geographical split did not carry over to the catastrophe models, where there was little difference between the number of respondents in each area using the software.

Where specialised actuarial software is used, it is usually considered to be important to the user, with most people placing it in either the vital or significant group. This may reflect over-reliance on software, and the difficulty people would have carrying out similar functions in non-specialised software. The economic scenario generators were considered less important to users. This probably reflects the low level of market and asset risks in most non-life company's capital assessments, and the relative ease with which a simple assessment of market and asset risks could be included without materially reducing the credibility of the model.

It is evident, and unsurprising, that different types of packages are used in different business areas.

6.2.1 Actuarial pricing package

Rather unsurprisingly, actuarial pricing packages are mainly used by people who primarily work in the pricing and outwards reinsurance area. There is also a tendency for people who do capital management to use pricing software, although this is possibly because of capital management actuaries doing pricing in their “spare time”. It was surprising to see the relatively low number of people overall using actuarial pricing software. It would seem that most people are comfortable with their own ad hoc templates, rather than a standardised system.

6.2.2 Actuarial reserving package

Again, rather unsurprisingly, there is a tendency for reserving actuaries to use reserving packages. Even fewer respondents use specialised reserving software than pricing software.

The structure contained within actuarial reserving packages was viewed as a benefit and also as a detriment. Such inflexibility inhibits the use of actuarial judgement (which may or may not be a bad thing!), so software providers may want to take some note of this for future releases.

6.2.3 Catastrophe modelling package

Catastrophe models tend to be used by people doing outwards reinsurance and catastrophe modelling. Nobody primarily involved in capital modelling used a catastrophe model, although no doubt a large number of them used the output from the catastrophe model to feed into their work.

6.2.4 DFA package

DFA packages were primarily used for capital management, but a large number of people involved in outwards reinsurance also used them. This is probably a reflection of their flexibility in handling difficult reinsurance structures within a Monte Carlo framework. A significant number of respondents rated the importance of DFA software as “Vital” for their work, reflecting the difficulty of carrying out complicated capital modelling work in in-house software. One oddity was the number of people doing capital management work without the use of DFA package. This suggests that there are a significant number of people using their own ad hoc methodologies for managing their capital.

6.2.5 Economic scenario generator

ESGs were mainly used by people within capital management, with actuaries doing pricing and reserving using them less often. This may change over time, as consistent assumptions (such as future inflation rates) get used within reserving, pricing and capital models.

6.3 Comments

Many of the comments from the respondents noted the relatively small range of actuarial packages, and their lack of flexibility.

- The choices of actuarial reserving packages are slim
- most actuarial reserve packages I've used are too inflexible.
- packages are not as flexible or adaptable as home-grown products

Given the recent press activity around catastrophe models, it is unsurprising that a number of respondents were vocal on the quality of these models. One of the politer comments made was:

- we're all disappointed with the modelling results relative to the last two seasons of actual hurricane losses

6.4 Discussion

Specialised actuarial software is in common use in the non-life actuarial community, with two thirds of the respondents using at least one package. The UK/Europe and US/Canada split is interesting, and suggests that regulatory pressures may encourage the use of specialised software to achieve a company's objectives.

Overall, the specialised software is very important for users (you would hope that the cost associated with the products meant that they were used!), although a number of people commented on the lack of flexibility compared to what they could achieve using more general purpose software such as Excel.

7 Other software

About 75 respondents, or 10% of our overall survey sample, said that they used software not falling into any of the categories that we specifically asked about.

Sifting through the responses it became apparent that this was where many of the more cutting edge actuarial approaches were being employed. It might not be too much of a stretch to compare this section to the 'Best new band' category at the music awards. Your insurance company (band) may not be undertaking these types of projects today, but if you want to stay towards the top of your peer group (charts) and sell profitable policies (records), you might want to consider employing such approaches in the not too distant future.

In this section we discuss a few of the more interesting software packages that people mentioned. We can't tell how widely used any of them are, as there may be many people who use them but didn't mention them in the open-ended questions.

7.1 MS Project

Microsoft Project is a management planning application that at its most basic level of engagement allows the user to create workflow plan flowcharts. A couple of examples of situations where it could be used are implementing ICA reporting across the business units of a U.K. domiciled company or planning the annual actuarial reserving and statutory reporting activity of a multi domicile reinsurance company.

The work plan would identify the necessary levels of actuarial staff resource. Further analyses might be to potentially identify the following:

Critical paths – A key member of staff might be involved in the preparation of an SEC return and also involved in the preparation of a regulatory return in another jurisdiction. By setting critical paths the more important project would be prioritized while the less important project could be postponed or allocated alternative resources.

A good ‘real-life’ example of how failure to adequately identify the stages on a critical path led to a two year delay in the opening of Denver International Airport [Demarco].

Bottlenecks – A ‘bottleneck’ occurs when a delay in completing part of project might have serious repercussions on the planned completion of subsequent dependant projects.

MS Project appeals to potential users with good spatial awareness skills. Maybe the fact that most actuaries have preferred to hone their numerical skills is a deterrent to more widespread adoption of this software.

7.2 Reinsurance Outwards recovery software

Outwards reinsurance programmes, particularly many of those placed in the London market more than a decade ago, can be notoriously complex. A number of third party software vendors have constructed software packages designed to assist a ceding company keep better track of recoverable reinsurance and potentially recoverable reinsurance.

These packages may also be of valuable assistance to the reserving actuary who needs to allocate ceded IBNR, particularly where limits on outwards reinsurance contracts may be exhausted.

Though these reinsurance outwards packages were mentioned in the survey on a couple of occasions, we suspect that actuaries, even those involved in reinsurance reserving, do not use them extensively. They are usually marketed to reinsurance managers, and in some cases, a company may possess this type of software without the actuary being aware of its existence.

7.3 Additional Pricing software

The survey revealed that a minority of actuaries employ specialist software packages for a number of applications over and above the ‘big four’ software areas of reserving, pricing, DFA and catastrophe modeling. In certain situations these software packages represent a refinement to basic reserving or pricing methodologies. Two ways in which actuarial pricing might be refined are through online database tools and geographical mapping software.

7.3.1 Cognos Powerplay

OnLine Analytical Processing (OLAP) is a means of extracting concise information through multidimensional analysis. OLAP might help trends in consumer behaviour or spot anomalies in insurance premium rates in a particular region.

PowerPlay draws information from relational databases to build PowerCubes®. Cubes can be datasets that go far beyond the dimensions of more common databases. Cubes can contain tens of millions of consolidated rows of data and hundred of thousands of data categories. Web, Windows and Excel can all receive cubes and their associated reports [Powerplay].

It is possible that in the future some form of data mining through consumer credit scores could be used as a variable in assessing an individual homeowner’s insurance premium.

7.3.2 MapInfo

MapInfo is a Geographical Information System (GIS) that is specifically targeted at the insurance industry. It provides visualization tools for relationships between data and geography.

“Over 85% of insurance data (sic.) has some location (element) – somewhere in the data record there is information that can be tied to a geographic area. Sometimes the information can be quite specific, such as a latitude and longitude coordinate for an insured property. Other times the geographic data will be in the form of an address that can be pinpointed on a map (geocoded), a zip code, state or country. Even the first six digits of a phone number can be used to tie a record to a place on earth.”
[MapInfo]

Shades of big brother in that last particular application!

The MapInfo website also provides several though provoking examples of how the software might assist in insurance decision-making. Some examples are:

- Underwriting & risk management – Risk aggregation and book analysis, risk proximity analysis, custom rating territory development.
- Claims management – Optimising claims resource allocation and adjustor schedules.

- Sales/Marketing – identifying cross-selling opportunities.

7.4 Data mining

Two data mining software products were mentioned by respondents.

SAS Enterprise Miner is the leading data mining application tool that has the advantage of being integrated with the SAS range of software. The SAS website touts examples of how the application identified niches of higher customer persistency and profitability. [SAS]

CART (Classification and Regression Trees) is another data mining tool whose website contains a number of case studies that describe general insurance actuarial projects. One example set in Australia describes the challenges associated with combining the pricing structure of two books of personal lines insurance business in a post merger setting [CART].

From an actuarial reserving perspective, a particularly interesting data mining technique subset of the data mining applications is known as ‘Text mining’. It is described in [Francis], which we recommend as good introduction to the technique and its use in insurance.

Text mining refers to a collection of methods used to find patterns and create intelligence from unstructured text data. Examples of unstructured data in corporate databases include claim descriptions, responses to open ended survey questions, and the comment field in reinsurance contract records.

The text mining paper sets out a number of examples of situations in which text-mining techniques were of assistance in insurance operations. One of the most startling examples is the investigation of fraudulent medical insurance claims.

8 Conclusions and further work

As noted in the Introduction, our goal was to learn more about how software is used by actuaries and shed light on any issues that we should be aware of as we reflect on how software affects our work. We believe that we succeeded in reaching our goal and, in summary, we reached the following conclusions:

- Spreadsheet software, especially Excel, has become almost universally used by actuaries. However, there may well be a significant proportion of actuarial users who are not aware of its limitations as far as statistical functions and random numbers are concerned. Emerging issues related to control procedures may lead to more use of other software, but are unlikely to dethrone spreadsheets as the main staple in the actuarial toolbox.
- Statistical packages are also popular, especially with pricing actuaries and for catastrophe modelling and capital management. Of the available

statistical packages, SAS is by far the most used, the one considered most vital and the one used most frequently. Many people, particularly in Europe, use specialised statistical software but R is also a popular choice. R appears to have the potential to become a much more important piece of software, if data size limitations can be overcome.

- Interestingly, however, statistical packages seem to be used far less often than spreadsheet add-ins such as @Risk or the Excel Analysis Toolpak. Given the prevalence of statistical analysis in actuarial work, we attribute this phenomenon to the use of simple cost / benefit analyses with statistical packages being reserved for more complex assignments. However, the analyses may well be over-simplified, in that they may ignore the limitations of the statistical analyses available in the Analysis Toolpak.
- For database software, Access is the mostly commonly used, probably due to its availability as part of the MS Office package. However, for larger or more complex databases SAS and SQLServer have been acknowledged by users as more suitable.
- Programming languages, especially VBA for Excel and Access, are almost as commonly used as spreadsheets and databases. Somewhat surprisingly, for the Access users far less than half also use Access/VBA which may indicate a more “hands off” approach to programming in Access. However, for Excel users a significant percentage also uses Excel/VBA which seems to indicate a more “hands on” approach to programming. Other programming languages are likely to be associated with more specialized purposes.
- Other software is also quite popular among actuaries, but this software tends to be very specialized by area of practice with, for example, reserving actuaries using reserving software packages and reinsurance actuaries using catastrophe modelling software.

Overall, there is some danger that actuaries are not making enough use of specialised software, preferring to rely on the trusty swiss army knife of Excel. While Excel can be persuaded to perform most functions, it is rarely as effective as purpose built software, and there are sometimes significant risks posed by its use.

We believe there is much useful further work that could be carried out. First, we performed only preliminary analyses of the survey data. It is likely that more sophisticated analyses would uncover other interesting patterns. Second, we believe it would be useful to collect more detailed data on specific areas of software use, including development methodologies and systems and controls. More than ever, actuaries rely on software they build themselves, and as professionals they should ensure that they are using best practice when doing so.

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APPENDIX A: Survey questions

Software use in General Insurance

1. Introduction

The GIRO working party on Software Use is trying to find out what software is used by GI actuaries and others.

Please help us by filling in this short, anonymous survey, which should take around 10 minutes. There are 31 questions. You may answer as few or as many as you like.

You may answer the questions in any order (use the Prev and Next buttons at the bottom of each page), and you can return to your answers and change them at any time until 10th March, when we will be collecting and analysing the results.

Please answer all the questions in the context of **your own personal day-to-day work** (rather than the whole organisation you work for).

One lucky participant will win a bottle of champagne (or non-alcoholic alternative). Thanks for your help!

2. About you

1. Do you work for

- A company?
- A broker?
- A consultant?
- Other (please specify)

2. What types of business do you work with? Check all that apply.

- Primary insurance
- Reinsurance
- London market/Lloyd's
- Personal lines
- Commercial lines

3. Are you

- A qualified actuary?

- An actuarial student?
- An accountant?
- A statistician?
- Other (please specify)

4. How long have you been working in GI?

- 0-2 years
- 3-5 years
- 6-10 years
- 11+ years

5. Where are you based?

- UK/Ireland
- Other Europe
- USA/Canada
- Other (please specify)

3. What do you use software for?

6. What do you use software for? Please check all that apply.

- Pricing
- Reserving
- Capital management
- Investments
- Outwards reinsurance
- Catastrophe modelling
- Statutory reporting
- Other (please specify)

4. Principal area

7. Please choose the main area in which you use software, and answer the remaining questions for that area only.

- Pricing
- Reserving
- Capital management
- Investments

- Outwards reinsurance
- Catastrophe modelling
- Statutory reporting
- Other (please specify)

The remaining questions in the survey are about your use of specific types of software. Please answer them in the context of your answer to this question.

5. Spreadsheets

Please answer these questions in the context of your answer to question 7, the main area in which you use software.

8. Which spreadsheet packages do you use? Check all that apply.

- None
- Excel
- Lotus
- Other (please specify)

If you answered "None", you can go straight to the next page using the Next button at the bottom of this page.

9. How often do you use them?

	Annually	Monthly	Daily	N/A
Excel				
Lotus				
Other				

10. How important are they in what you do?

	Vital	Significant	Useful	Waste of time	N/A
Excel					
Lotus					
Other					

11. Any other comments, eg useful features, drawback, other areas in which you use spreadsheets.

6. Spreadsheet add-ins

Please answer these questions in the context of your answer to question 7, the main area in which you use software.

12. Which spreadsheet add-ins do you use? Check all that apply.

- None

- Excel Analysis Toolpak
- @Risk
- Crystal Ball
- XLStat
- In house add-in
- Other (please specify)

If you answered "None", you can go straight to the next page using the Next button at the bottom of this page.

13. How often do you use them?

	Annually	Monthly	Daily	N/A
Excel Analysis Toolpak				
@Risk				
Crystal Ball				
XLStat				
In house add-in				
Other				

14. How important are they in what you do?

	Vital	Significant	Useful	Waste of time	N/A
Excel Analysis Toolpak					
@Risk					
Crystal Ball					
XLStat					
In house add-in					
Other					

15. Any other comments, eg useful features, drawback, other areas in which you use spreadsheet add-ins.

7. Statistical packages

Please answer these questions in the context of your answer to question 7, the main area in which you use software.

16. Which statistical packages do you use? Check all that apply.

- None
- GLIM
- Matlab
- R
- SAS
- S-Plus

- SPSS
- Statlab
- WinBUGS
- Other (please specify)

If you answered "None", you can go straight to the next page using the Next button at the bottom of this page.

17. How often do you use them?

	Annually	Monthly	Daily	N/A
GLIM				
Matlab				
R				
SAS				
S-Plus				
SPSS				
Statlab				
WinBUGS				
Other				

18. How important are they in what you do?

	Vital	Significant	Useful	Waste of time	N/A
GLIM					
Matlab					
R					
SAS					
S-Plus					
SPSS					
Statlab					
WinBUGS					
Other					

19. Any other comments, eg useful features, drawback, other areas in which you use statistical packages.

8. Databases

Please answer these questions in the context of your answer to question 7, the main area in which you use software.

20. Which database packages do you use? Check all that apply.

- None
- Access
- mySQL
- Oracle

- Postgres
- SAS
- SqlServer
- Sybase
- Other (please specify)

If you answered "None", you can go straight to the next page using the Next button at the bottom of this page.

21. How often do you use them?

	Annually	Monthly	Daily	N/A
Access				
mySQL				
Oracle				
Postgres				
SAS				
SqlServer				
Sybase				
Other				

22. How important are they in what you do?

	Vital	Significant	Useful	Waste of time	N/A
Access					
mySQL					
Oracle					
Postgres					
SAS					
SqlServer					
Sybase					
Other					

23. Any other comments, eg useful features, drawback, other areas in which you use database packages.

9. Programming languages

Please answer these questions in the context of your answer to question 7, the main area in which you use software.

24. Which programming languages do you use? Check all that apply.

- None
- Excel/VBA
- Access/VBA
- Fortran

- Visual Basic
- C/C++
- Java
- Other (please specify)

If you answered "None", you can go straight to the next page using the Next button at the bottom of this page.

25. How often do you use them?

	Annually	Monthly	Daily	N/A
Excel/VBA				
Access/VBA				
Fortran				
Visual Basic				
C/C++				
Java				
Other				

26. How important are they in what you do?

	Vital	Significant	Useful	Waste of time	N/A
Excel/VBA					
Access/VBA					
Fortran					
Visual Basic					
C/C++					
Java					
Other					

27. Any other comments, eg useful features, drawback, other areas in which you use programming languages.

10. Other software

Please answer these questions in the context of your answer to question 7, the main area in which you use software.

28. What other types of software do you use? Check all that apply.

- None
- Actuarial reserving package
- Actuarial pricing package
- DFA package
- Economic scenario generator
- Catastrophe modelling package

Other (please specify)

If you answered "None", you can go straight to the next page using the Next button at the bottom of this page.

29. How often do you use them?

	Annually	Monthly	Daily	N/A
Actuarial reserving package				
Actuarial pricing package				
DFA package				
Economic scenario generator				
Catastrophe modelling package				
Other				

30. How important are they in what you do?

	Vital	Significant	Useful	Waste of time	N/A
Actuarial reserving package					
Actuarial pricing package					
DFA package					
Economic scenario generator					
Catastrophe modelling package					
Other					

31. Any other comments, eg useful features, drawback, other areas in which you use other software.

11. Thank you

Thank you very much for taking part in this survey. We appreciate your input. We'll be presenting the results at the GIRO conference in September.

If there are any issues that you'd like the working party to consider, please send email to softwarewp@ANTISPAMlouisepryor.com (removing the antispam characters).

There is a prize of a bottle of champagne (or non-alcoholic alternative) for one lucky participant; if you want to enter the draw, please give us your name and email address.

32. If you'd like to enter the draw, please enter your name

33. ... and email address

References