Using Minitab for teaching statistics in higher education

John Eales
School of Mathematics and Statistics
University of Plymouth
john.eales@plymouth.ac.uk

Julian Stander
School of Mathematics and Statistics
University of Plymouth
julian.stander@plymouth.ac.uk

Abstract

We discuss our experience with the software package Minitab 15 in the teaching of statistics in higher education. We contrast the use of Minitab with that of other packages, highlighting its many advantages.

1. Introduction

Minitab [1] was developed at the Pennsylvania State University, USA, in the early 1970s by Barbara F. Ryan, Thomas A. Ryan, Jr. and Brian L. Joiner. It has been regularly updated and improved over the past 35 years. The current version, Minitab 15, produces fine graphics and has a good range of built-in functionality, including generalised linear models, time series analysis and multivariate statistics. It is used by a number of large multi-national companies including Ford, and is also employed in the teaching of statistics across the world.

Minitab 15 is Windows based and can be either menu or command driven. Upon starting Minitab, the user is presented with a split screen comprising a Session window, where commands may be entered and output is shown, and a data worksheet. There is also a menu bar at the top of the screen.

2. The University of Plymouth experience

In the School of Mathematics and Statistics at the University of Plymouth we teach a wide range of statistics modules across the institution. These vary from introductory courses taught to service students through to advanced modules delivered to our own Applied Statistics degree and masters students. The choice of software is usually a key decision in the delivery of these modules and we currently use a variety of packages including: Minitab, Microsoft Excel, R [4], SPSS and STATGRAPHICS Plus. We have also used GenStat, GLIM, SAS and S-PLUS in the past.

There are arguments to be made in favour of each of these packages and we certainly would not wish to detract from the almost overwhelming case for using R [4] to conduct highly sophisticated analyses and research. We would also advocate using Microsoft Excel as an excellent interactive tool for learning statistics. For example, in our teaching we successfully use Solver to demonstrate maximising likelihood functions and minimising sums of squares in simple regression analyses. However, we would argue that Minitab is an excellent all round package which has clear advantages over its competitors in the delivery of the majority of undergraduate work, particularly service teaching.
The main advantage of Minitab is its beautiful simplicity which makes it easy to learn and use. In our experience, a single introductory session is all that is required to get even relatively computer phobic and statistically illiterate students up and running with the package. Perhaps even more importantly, students remember how to drive the software weeks or months later. Other packages are harder to use and students often get frustrated when trying to remember such basics as how to read in or enter data.

These points are readily illustrated by our many years of experience on a module taught to foundation students on the Extended Science programme at Plymouth: Statistics for Extended Science. This course has a relatively high percentage of mature students, many of whom find mathematical subjects difficult and very few of whom have previously studied any statistics. The first five weeks of the module are devoted to descriptive statistics. At the end of this section a summary lecture is given during which data from a real scientific experiment are analysed. Minitab is introduced to the students at this point, with the lecturer giving a quick demonstration of the package. Although this demonstration, together with an introductory handout, is the only instruction that these students are given on Minitab, many students regularly choose to use the package for the module’s coursework. We know from this coursework and from module feedback that the students find the software simple to use and highly effective.

As an example, we consider a recent coursework on Statistics for Extended Science based on a problem that we have somewhat modified from the excellent text by Clarke [2]: three chemical compounds, A, B and C, are being tested as potential protective fungicides against apple mildew.

A total of 90 plants were used in the experiment, with 30 plants being randomly assigned to each compound. At the start of the experiment each plant was dipped into a suspension of the appropriate compound. Afterwards, the whole collection of plants was placed in a closed environment which was infected with mildew spores. At the end of the experiment the number of lesions on the first leaf of each plant was counted.

This data set was given to the students for analysis. Their task was to compare the effects of the three chemical compounds on the plants by producing suitable tabular, numerical and graphical summaries of the data and to write a short report on their analysis. Fig 1 below shows a screen shot of some of the analyses carried out in the coursework and was easily produced with a few menu driven commands. The resulting output can be saved for future use. Students find it straightforward to copy and paste such output into Microsoft Word and so have the satisfaction of being able to produce a professionally presented report of their work.

Similar analyses could be undertaken in R [4]. Although R is free, it has the disadvantage of being command line driven. Because of this, at the University of Plymouth we teach R using the excellent Tinn-R editor [3]. This helps students with the syntax of their commands, and allows them to revisit their work easily. However, to achieve the Minitab analysis shown in Fig 1 in R, students would have to type correct commands to read in their data, to provide group level summary statistics and to produce a suitable graph. Some of these commands can be quite sophisticated and lack ease of interpretation for novice users. In addition, students have to become familiar with Tinn-R and its

![Fig 1 – Easily obtainable Minitab output showing graphical and numerical summaries for the number of lesions on plants treated with three chemical compounds A, B and C. Students enjoy discussing what action to take about the clearly visible outlier.](image-url)
interaction with R. Moreover, it is our experience that when students return to their Tinn-R work after a long period of time, considerable intellectual effort is required for them to understand what they have already done before they can proceed with additional analyses. Minitab does not suffer from this drawback. Indeed, the process of re-starting work with Minitab is an immediate one.

As mentioned, Minitab output can be easily transferred into Microsoft Word. This is also possible with R, and with many other packages, but our experience is that with Minitab the procedure is very direct with little additional editing being required.

**3. Further advantages of Minitab**

As well as its simplicity, we would argue that Minitab has the following additional advantages:

**a. User friendliness**

As well as being easy to use, Minitab has an extremely good help facility and excellent electronic manuals. Data entry is straightforward and it is a simple task to cut and paste data from another package such as Microsoft Excel into Minitab. By contrast R help files, although excellent for more experienced users, are often ignored as a source of information by novices because of the fear that their sophisticated format can evoke.

**b. Graphics**

There is a good choice of graphics on Minitab including bar charts, pie charts, scatter diagrams, histograms and box and whisker plots. The quality of these graphics is impressive and it is very straightforward to edit them. R too offers excellent and highly customizable graphics facilities, but again for the novice user these can be somewhat daunting. We have seen some students, especially mature students, who have become very discouraged when trying to produce simple graphs in R because a small syntax mistake, such as typing “1” instead of “i”, causes an error. We have no doubt that teaching elementary graphical displays using R requires considerably more staff input than with Minitab.

**c. Functionality**

A wide range of statistical analyses is available from Minitab. These range from descriptive statistics, through regression modelling and analysis of variance, to generalised linear modelling, time series analysis and multivariate statistics. Minitab macros may be written to extend this functionality. This means that Minitab can be used on intermediate and even advanced statistics modules as well as introductory ones. At Plymouth, for instance, we use Minitab to teach regression and analysis of variance on second year modules on our Applied Statistics degree. In recent years, however, we have also provided students with R code to replicate their Minitab analyses. This gives students considerably flexibility when it comes to their final year dissertations and allows them to write reports that show their ability to use a variety of packages.

**d. Output**

The quantity and quality of default output on Minitab is both sensible and good. When required, more detailed output is easily obtained through various options on the menu boxes. Sensible default output is a clear advantage of Minitab as students can often be intimidated when faced with unnecessarily lengthy results from simple analyses. Here, Minitab may be favourably compared with SPSS which we are required to use to teach students on psychology programmes. Our experience is that the default SPSS output is voluminous, and much teaching effort is spent on getting students to focus on the salient parts. Often, students using SPSS are sidetracked into spending time investigating irrelevant statistics and tests, and this can lead to future inappropriate analyses.

**e. Licences**

The University of Plymouth’s licensing agreement with Minitab allows students to obtain a free copy of the software for their home computers. Whilst not a unique agreement, this is certainly one reason why we have recently taken the decision to replace certain other packages with Minitab on some of our service courses at Plymouth.

**Conclusions**

Based on our many years of experience, we have outlined several of the advantages that Minitab offers over other packages in the context of teaching statistics to students who may find mathematical subjects difficult and who may be studying statistics for the first time. It is easy to produce relatively sophisticated numerical and graphical summaries of data using Minitab, and straightforward to revisit analyses. We highly recommend the use of Minitab for this large group of statistics students. We also believe that Minitab has an important role to play in other teaching contexts in higher education.

**References**


