WRITING

PROJECTS, REPORTS, THESES and PAPERS

in

MATHEMATICS and STATISTICS

J.C.W. RAYNER
SCHOOL OF MATHEMATICS AND APPLIED STATISTICS
UNIVERSITY OF WOLLONGONG

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PREFACE

This report was stimulated by the need of many students who either are required, or who wish to write, reports, projects, papers or theses in Mathematics, Statistics and related subjects. My experience ranges from assisting my own children to do projects for school competitions, supervising university students with honours year projects and higher degrees, and writing my own research reports, papers and books. I hope this report will be especially useful to students doing a project as part of their honours degree. Please let me know of any errors, omissions, advice with which you disagree, and any other difficulties.

As well as what the body of this report says, the reader should look at what it *demonstrates*. So far you have encountered a title page, deliberately brief and to the point, with the title and author clearly shown. Now you are reading an informal and in some circumstances, unnecessary, preface. It should contain a brief statement of the motivation, aims and outline. Include any acknowledgements to people who have assisted with technical advice (such as how to do something, or where to look for information) and encouragement. In published material other acknowledgements will have to be made for copyright and other reasons.

Even in relatively short reports, a list of contents is a good idea. It helps the reader to see the structure of the whole work, to relate each part to every other part. Then the main body of the report follows. This is made up of chapters, each with clearly titled sections and possibly sub-sections. This may sound too grand for what you have in mind, but even in something shorter, there is a strong parallel. The chapters may really only be sections and the sections only paragraphs, but each should have an obvious purpose. At the end, list together in the References any books or articles you have referred to in the text. The interested reader may wish to read further, or check some of your assertions.

This then is the structure of a typical report. How a report relates to a project will be clarified in section 1.1. The structure described can be modified to apply to other presentations. How to write reports is not a trivial matter. Substantial books have been written on the subject and you may wish to read some of them. Check the university and town libraries, the bookshop, and staff from the School of Mathematics and Applied Statistics. The Annotated Bibliography that concludes this report is a good place to start. At this point, the aim is to give some helpful advice that can be read in at most a couple of hours and referred to as the need arises.

I would like to record my thanks to Allyson Seyb for assistance in researching and writing an initial version of this report. Also a grant made by the Otago University Research Committee is gratefully acknowledged. Carol Rayner researched and wrote the Annotated Bibliography, and read and constructively advised on various drafts of this report.

John Rayner

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1 INTRODUCTION

1.1 Projects, reports, theses and papers

No matter who you are or what you do, communication affects how well you get on with other people, how successful you are in the variety of things you try to do, and how you feel about yourself. When word of mouth is not possible or not precise enough, written *reports* are the way professionals communicate with each other. The information should be presented accurately but also so that it can be absorbed relatively easily.

By *papers* I mean reports that are published, sometimes in international journals, with the aim of keeping experts up to date with the latest developments in an area. Because space is relatively expensive in publications, papers tend to be more concise than reports. Fewer diagrams and figures are presented because words are used if at all possible, since they take less space, and hence cost less.

Theses lie between reports and papers. They are not published and can therefore give more detail. Theses are usually presented for the award of higher degrees at universities; they make original contributions at a high technical level.

A *project* may include a report. The information may be presented using a variety of devices, such as posters, videos and models, possibly augmented by a written report. The informal projects of the early school years become more formal throughout school, and these are the preparation that some of us undergo before writing reports for higher rewards in business and education.

Most readers will be reading this with a specific objective in mind, and will know the sort of document they want to achieve. For those others, be aware that different forms are appropriate for different objectives. Know what you're trying to do, and be inventive in how you do it. For example, if a computer program is a necessary part of what you must do, why not demonstrate it interactively to your assessors? The impact may be much greater. In all cases visualize the finished product. Is it what you want?

1.2 Common threads

What do projects, reports, theses and papers have in common that can sensibly be discussed together? Looking at the Contents headings will give a brief indication. All involve related problems of supervision, access to information, keeping objectives in mind, knowing how to present the information and achieving the best possible results.

No matter why you are reading this, what you discover here and in seeing your work through to completion will assist you with future presentations.

1.3 How are Mathematics and Statistics reports different?

In several respects Mathematics and Statistics reports are not different from reports in other areas. In all areas good supervision is invaluable. Adequate planning, clear writing and sensible presentation are very important.

However, some things are different.

(i) Often there is very little appropriate *reference* material. It may not be at your library, it may be in a foreign language or it may be at the wrong level: either too simple to be worthwhile, or too difficult to understand.

(ii) In the sciences in particular, much of the information is best presented in equations or symbols that must be motivated and defined. There are also problems with both their expression and presentation. For example, which is the better presentation for the sine rule:

$$a/\sin A = b/\sin B = c/\sin C, \tag{1}$$

or

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}? \tag{2}$$

Most readers find the latter easier to read, but the former is easier to type, because all symbols are on the same level. If you are using a sophisticated typesetting program such as *LaTex*, then uniformity of layout and a good product are guaranteed. However most of us start out presenting handwritten material, then graduate to simple wordprocessors, and then to more sophisticated products such as *Word* with expressions and equations being produced by *Equation Editor*. Equation (1) can be written using the simplest wordprocessors; *Equation Editor* produced (2).

However it is expressed, the symbols used in the equations representing the sine rule must have been defined. In a long document, a summary of the notation may be useful.

(iii) Writing with symbols has many *pitfalls*. Try to avoid multiple levels of superscripts and subscripts, such as $E_{\theta_i}\left[\bar{f}^{\tau *}_{X_1}(X)\right]$. Systematic use of upper and lower case, Greek and Roman is helpful to the reader. Don't introduce definitions and symbols that are used only two or three times. On the other hand, complex expressions can be simplified and their interpretation clarified by judicious substitutions, such as "$z = f(y)$ where $y = g(x)$, in which g = ..." Avoid using the same notation for different purposes in the same document, and similarly avoid using different notations for the same purpose. Briefly returning to the point made in (ii), instead of incorporating mathematical material into the text, it is much easier for the reader if it is highlighted. So readers would usually prefer

$z = f(y)$ where $y = g(x)$, in which $g = \ldots$.

But would you highlight

$$E_{\theta_i}\left[\bar{f}_{X_1}^{\tau *}(X)\right]?$$

(iv) Many scientists, and mathematicians especially, are not particularly adept verbally. We tend to be predominantly non-verbal, so the verbal skills need constant practice. How much science has to be rediscovered because the original discoveries were poorly presented and therefore misunderstood?

(v) Research in some disciplines is merely collating available information. Science, and mathematics in particular, gives scope for investigating original material. Typically this is applying existing techniques to new areas.

2 PLANNING

2.1 Broad planning

Start early. This may appear to be difficult. A few months delay may mean extra knowledge and skills, or extra maturity without which a successful project is not possible. If that is true, then maybe the wrong topic is being contemplated. Starting early is important because there is preliminary organisation and reading that can be done, as well as valuable skills that can be acquired.

Approach likely supervisors and ask if they are willing to assist you, if so to what extent, and what topics they can suggest. Ask for preliminary reading so that you can narrow the choice of topics.

If you do not already have the necessary computer skills, then starting to develop them in the early part of a project that takes sufficient time is a worthwhile investment. Some topics will involve computation (number crunching), and of course word processing will be necessary if the final product is to look professional. Also reading material on report writing is appropriate! These skills will be valuable long after the project is finished!

2.2 Supervision

Many projects, reports and theses assess the supervisor more than the author. Why? Because a committed and conscientious supervisor will be able to see, in outline, a reasonable project before the student starts. If there are unsolved problems the supervisor should know approaches that are likely to be successful. If these fail, there should still be enough in the topic for a reasonable grade to be obtained. The supervisor will know most of what should be read and where to find it.

Knowing all this, a good supervisor will not accept a particular student with a particular programme if there is any doubt that this student has the ability to complete this programme. Of course the programme may not be completed adequately if the student isn't sufficiently organised or doesn't work hard enough. Conversely a poor supervisor can be a liability.

There are many sorts of project: some possibilities are given in section 4.1. The supervision skills required for these different possibilities are, not surprisingly, different. No supervisor can reasonably be expected to have all the skills for all possible projects. Required skills may include the following:

(i) assisting the student to develop the library skills to either initiate or complete a literature search;

(ii) advice about mathematical or statistical techniques and appropriate computer software;

(iii) firm advice about the direction an investigation should take and the techniques that may be used;
(iv) motivation to encourage, and moral support when the student is depressed;
(v) practical advice about organisation and presentation.

Personality clashes are always a problem. It is very unrewarding for both student and supervisor if they are obliged to work together when one doesn't get on well with the other. Neither student nor supervisor should expect too much of the other.

2.3 Topic selection

Wishing to start early, suppose you are about to approach a prospective supervisor. What do you hope to achieve from the first interview? First do not ask for supervision on a topic you have selected. Even if the prospective supervisor agrees, it is likely to be a mistake. This person may be an excellent supervisor on a topic of his or her choice, about which he or she is motivated. On your topic this person may not know enough of the background, and not be enthusiastic enough to help you as much as you need.

It is sufficient usually to specify your broad interests, and ask the supervisor to nominate topics with which they are prepared to assist you. Possibly you want a computationally heavy topic, because you are have good skills in this area and you hope these skills will be an important part of your intended career. Or possibly the reverse is true. Maybe you'd like to review some particular area that has captured your imagination, and you hope this review will provide the background for further work you would like to do later on. Or perhaps you enjoy reading around more than problem solving.

As a prospective supervisor, my response at this stage is to say whether or not I will be able to work at all with this student. It may be that I'm overcommitted and don't have the time to work with anyone (or anyone extra!), or with anyone with the broad restrictions they have just indicated. Maybe I have to be honest and say I don't believe the student has the technical ability to handle the topics in which I'm interested. Otherwise I produce two or three topics that appear to meet the student's needs, and with which I am prepared to become involved. By producing a topic I mean writing about a description of about one page on the problems to be addressed and finding some background reading so the student can make an informed choice between the topics. On the basis of the topics produced and the expectations of the supervisor, the student goes away, reads, thinks and decides who to work with and on what topic.

If you are desperately keen to work on a particular topic, finding an appropriate supervisor may be difficult. Nevertheless discuss the topic with possible supervisors. Hopefully they will examine your motives and try to construct a programme that is compatible with their and your interests and abilities. This problem becomes more and more difficult as the stage of the student, and the time to complete the project increase.

This is now the time to say what the supervisor expects of the student. Will there be weekly or monthly meetings to review progress and answer questions? The deadlines involved and likely time commitments should also be discussed.

2.4 A specific plan

By now it should be possible to write down specifically what is to be done and by when it is to be done. The student should write a description of the project, and this should be modified until the supervisor/teacher and student agree. Such a statement of aims and objectives will eliminate differences of opinion at a later date. In some circumstances an interim report may be required, possibly presented verbally. Likewise at the conclusion of the project another presentation could be given, to discuss the results obtained and how well the aims and objectives have been achieved. The value of a verbal as well as a written presentation is that the presenter has to have a different appreciation of the material. This can often clarify perspectives for the presenter as well as informing the audience. More will be said of this later. Thought should be given to whether other evidence of work done and other presentations are appropriate.

Meetings with the supervisor should be agreed to: they will be nil, weekly, fortnightly or as required. It is prudent for both student and supervisor to keep a record of all meetings.

In many cases it will be possible to modularise the work. These modules may be tasks or particular phases of the project. The student reports back to the supervisor as each module is completed. If satisfactory, this aspect can be written up. This approach has several advantages. It prevents the student from wasting time and effort working on false assumptions, possibly trying to prove impossible hypotheses. It also makes the final write-up far less daunting, since it is merely a rewrite, with the aim of improving organisation and clarity.

A maximum size should be specified from the beginning. It may require some skill and effort to keep within the prescribed limits. Failure to observe this requirement is normally reflected in the assessment. Of course assessment isn't everything: but you should be aware of the cost of doing and not doing various activities.

Allocate your time moderately and fairly between your commitments. There are good reasons for this. When more than one paper or project is being done for an award, the marks given are usually scaled, so that the raw marks don't mean much in themselves. What is meaningful is the ordering of the marks relative to the rest of the class. Two projects may both be awarded full marks by their assessors, but one may require many times the effort of the other. One may contain deep and beautiful mathematics that most professional mathematicians would having difficulty understanding, despite the clear and accurate presentation. No doubt such an effort is extremely beneficial in terms of the mathematical development of the student. In terms of marks awarded, much of the time

taken would have been more profitably spent on the candidate's weaker subjects. Most assessments are concave in that the first marks are more easily obtained than the later marks. Beyond a certain point, more time may not mean more reward. Conversely too little effort is just as bad.

3 OTHER REQUIREMENTS

3.1 Statement of aims and objectives, interim report

If written statements or reports are required, they should be assessed and the marks given should contribute to the overall grade. It is not unreasonable that the initial statement of aims and objectives should be given 5% or 10% of the overall mark: it is important to be clear about what is to be done.

Similarly an interim report after about one third of the time allotted is valuable. It could be either written or orally presented. The final assessment is likely to be more reliable, that is, to accurately reflect the abilities of the student, if the assessment is spread over time and over as wide a range of skills as is possible. An interim presentation permits other people to make helpful suggestions before the student is irretrievably committed to a poor methodology, or other mistakes.

In the same vein, a final summation helps the assessors give a more accurate grade to the project. Some students may do a lot of valuable work that doesn't appear in the final report. For example, finding relevant literature may take a lot of effort, and this should be rewarded. In doing independent research, many approaches may not yield useful results, but the trying is important. For example, in trying to solve an integral, many algebraic and trigonometric substitutions may be attempted and tables of standard integrals consulted before finally successfully using a numerical approximation. The unsuccessful attempts tell the assessors about the range of techniques the student has available, and the difficulty of the problem. A brief statement of the difficulties encountered should be included in the written report. However an oral summation sometimes tells "all". It may indicate what proportion of the final effort was the student's, and what was contributed by the supervisor and other interested parties.

3.2 Oral presentations

So much of our communication is oral, that it is worthwhile to practice and improve that aspect of our skills. On the other hand there are very few naturally gifted speakers. What can we do to make any sort of public speech less of an ordeal? Here are a few tips.

(i) *Prepare thoroughly*. Have something interesting and informative to say and the audience will want to hear it. Spontaneity makes for a more vital presentation, but most of the material should have been well considered.

(ii) *Speak to your audience*. Talk in language they can understand on subject matter they should be able to grasp.

(iii) *Use your time*. The well-prepared speaker should not have to accelerate to fit it all in, nor have time to fill with irrelevancies.

(iv) *Vary the content and presentation*. There should be parts that are easier to understand (such as cartoons and personal philosophy) between the difficult concepts. It also helps to use a variety of means to get the message across. For example some written content may be handed out, some shown on prepared slides using an overhead projector, and some written on a blackboard. Overheads should be brief, without too much mathematical detail. Remember that some of your audience may be colourblind, hard of hearing, or have poor eyesight. They will appreciate your efforts to make sure they have the same access to your material as the rest of the audience. The rest of your audience will appreciate the additional clarity of your presentation. Start with something pithy, relevant and attention grabbing, such as a quotation. Finish in a memorable manner, so that the audience will remember what you've said.

(v) *Talk to the people, not a spot on the wall*. After all, you do so in everyday conversation, so why not at more formal presentations?

(vi) *Don't distract the audience*. Stand or sit still, don't pace around drawing attention to you rather than your subject matter. Some movement is inevitable, and being animated about your topic is good! But be moderate in your movements.

(vii) *Expect something of your audience, and make them know it!* A good listener should be trying to follow the detail and outline of what is being said. They will be prepared, if circumstances allow, to interrupt the speaker to ensure this is the case. Likewise the speaker should be prepared to check the audience to see if they are following the presentation. You should be able to tell by their eyes!

(viii) *Allow time for the inevitable interruptions and for questions from the audience afterwards.* If you are inexperienced, have a timed trial before the big event, preferably in front of a friendly audience.

If you really are awful, write down every word you intend to say, and read it. This really is a last resort. It is much better to have prepared transparencies, handouts or material on a blackboard, and to talk to this material.

Having thought of a topic, started inquiries about obtaining the necessary information and materials, and considered the requirements of the entire project, there is at least one other matter to consider before actually doing anything.

4 ASSESSMENT

4.1 Know the assessment criteria

Before beginning the task, you should know how it is to be assessed. How can you hope to do a good job if you do not know what a good job is? Of course different people will have different expectations, and if you are to be assessed by more than one individual, you will have to bear in mind these differences.

Different topics require different criteria. However some things are universal: it will always be appropriate to have correct spelling, legible writing, clear expression, informative figures and sensible organisation. The level of difficulty of the material, independence and the range of skills demonstrated will be different for different topics. Consider the following styles of projects:

(A) an investigation is conceived, data collected, analysed and conclusions drawn;

(B) a substantial body of work is reviewed, organised and reported upon;

(C) some material is reviewed, and then demonstrated, perhaps through computer simulations.

(D) familiar techniques are applied to a non-familiar situations to produce original results.

Given the *style* of the project, the supervisor or assessor should be able to specify the criteria to be used and the weights to be given to each. The writer then knows *fully* what is required, and by implication, what is to be avoided.

Some assessors will not be pinned down. They seem to be guided by 'gut' reactions, and aren't able to specify their criteria. Even if they could, the assessment seems to be made independently of the criteria, and then marks given to conform with the decision. The best advice in these circumstances would be to look at previous projects marked by this person, and then try to find factors common to the 'good' projects, and factors common to the 'bad' projects. There is room for some independence, but avoid the 'bad' factors.

4.2 Possible criteria

Many criteria have been suggested, and it is not the intention here to give a complete listing of these. Indeed the criteria selected are often a matter of personal taste for the assessor. Some possibilities are:

(i) Aims; (Have the aims been clearly stated and have they been achieved?)

(ii) Difficulty; (Have understanding or mastery been demonstrated? Less should be expected with more difficult material.)

(iii) Originality (of the background reading, analysis and conclusions);

(iv) Presentation (legibility, spelling, grammar, expression, organisation, referencing, tables and figures);

(v) Skills demonstrated (breadth, appropriateness, difficulty);
(vi) Other tasks (statement of aims and objectives, interim report, oral presentation of final report).

The four styles of projects (A) to (D) would require that the components be weighted differently and perhaps interpreted differently. For example a project on games may require some initiative in finding suitable background reading of relevance. Simulation may be used to play a particular game many times and so evaluate different strategies. Probability theory could be used to the same end. Simple games such as Ludo or noughts and crosses, or complex games such as poker could be considered. The options taken will affect the weights assigned to the different components.

5 WRITING AND PRESENTATION

5.1 Begin at the end

How do you want your report to look when it is finished? It could be bound relatively inexpensively, with transparent plastic covers. You may prefer to use a standard ring binder. Whatever your choice, it will affect the setting of the margins on each page. The main criterion should be the convenience of the readers. Most reports are not read many times, so that durability is not as important as it is for, say, popular library books.

What medium will you use to write the report? Word processors are marvelous in that corrections are easy to make, and reorganizing sections by cutting and pasting is very easy. But writing using a word processor is different from direct writing with pen or typewriter. One tends to repeatedly "improve" the text.

If you do not have access to word processing facilities, I suggest writing the first drafts in pencil. The lead should be medium-soft so that erasing with a rubber is easy. Also mathematical equations are often very difficult to set out on a typewriter or word processor, but look "right", at least to the author, when written by hand. If the lead is soft enough, the final version can be photocopied and will be dark enough to read easily.

Employing a typist to convert your text to professional quality output may sound attractive, but be careful. Not many typists have experience with mathematical symbols, and confusion may easily occur. It is also difficult to make repeated corrections to typescript. So the version that goes to the typist, in ample time, must be the *final* one.

Whatever medium is used, the final presentation should be generously spaced, without messy alterations, on one side only of the paper and with clear diagrams.

At the beginning of writing start a "conventions" list. On it write every decision you make that you'll have to refer to again. In particular the style and spacing of all headings should be recorded. In this report the chapter headings are centred, bold large script, and then ruled off. The section headings are bold, not underlined, left adjusted (flush with the left-hand margin), with the first word capitalized and subsequent words in lower case. After the chapter heading ruleoff, or the last word of a section, a line is left and the next heading begun.

Conventions for tables, figures, the preface, contents, index and references all have to be made. An example of a table is given in Table 5.1.

Apart from a system of numbering and a clear label, the detail is not as important as consistency within the text.

Table 5.1 Observed and expected eaths due to the major diseases.

Disease	A	B	C	D	Other	Total
Observed deaths	43	76	85	21	83	308
Expected deaths	46.2	64.7	55.4	43.1	98.6	308

5.2 Broad writing objectives

Plan ahead in every aspect! That means

(i) Know the content of every chapter, section, paragraph and sentence before trying to compose the words. For example, the chapters may be Introduction, Methods and Materials, Results and Discussion. If the Introduction attempts to achieve four aims, one paragraph could be given to each.

(ii) Keep the words simple and the sentences short.

(iii) Be prepared to rewrite and re-rewrite.

(iv) Invite at least one person to read and constructively criticize the manuscript.

5.3 Specific writing objectives

Take and keep a particular point of view with regard to

(a) tense - usually use the present tense; but imagine someone reading your prose next year;

(b) active or passive voice ("*one* may show that... " or "*I* show ... ");

(c) vocabulary - write for your peers, not the supervisor or assessor; and don't try to impress: it interrupts the flow and is usually counterproductive;

(d) clarity - know what you mean by each sentence and be sure the sentence does the job; the same applies to paragraphs and higher sectioning;

(e) mechanics - get them right, if necessary by first checking appropriate references. By mechanics I mean at least grammar, punctuation, abbreviations, symbols (use Greek or Latin?), footnotes, citations, quotations, headings, numbers (in English up to ten, and symbols after that?), capitals, italics and bold (when are they to be used?), quotations, references, how and where to number pages. With regard to capitals, countries are in upper case, as in Australia. But sometimes it is unclear, and you must simply make a decision and stick to it. For example, when should university be capitalized? The University of Wollongong is my University, not just any old university.

Decide on an *outline*, perhaps after checking the layout of some books or other projects that you find pleasing. The outline may include title page, preface,

acknowledgements, contents, list of figures, list of tables, chapters incorporating an introduction, body, discussion, conclusions, recommendations, followed by appendices, glossary (word and symbol definitions), references, index.

The purpose of the *appendices* is to enhance the flow of the presentation by removing some of the detail for consideration elsewhere. Appendices may include computer programs, proofs of theorems, complete data sets. Also include additional information about procedures you have used, so that others can duplicate your investigation. The list of *references* enables the reader to seek more detail about issues raised. It is important that all work not your own be acknowledged through the references. Failure to do so is cheating. Reading widely and synthesizing a point of view is an important skill, and not secondary to independent research. There should be a balance between the two, and the assessors should be easily able to see that this is the case. There are many possible formats for references. Some libraries have handouts describing their own system. Otherwise look for statements in abstracting services, professional journals or a convenient book. Normally I would not list references under different headings and annotate that list as has been done for this document. Check the conventions used in whatever sources are available to you and adopt those that most suit your needs.

Having written the text, now is the time for *revision* and *criticism*. Have you achieved your objectives? Is the organisation coherent and does the finished product read easily? Is it balanced, with adequate conclusions and without, say, a massive body and limp ending. These things are difficult to judge immediately you finish writing. Give yourself time to distance yourself from the detail before assessing the whole. It is usually best to let someone else look at it before the final assessment. Give that reader ample time to correct your semifinal draft.

6 CONCLUSION

6.1 Finale

Many of us, when we finish most tasks, rush onto the next one. When you finish your report, stop and think. What caused the most problems? What did you learn? If you had the option, would you choose to do another one? Remember the finished product says something about you at the time you wrote it. If the product is good, you can use it as a reference, perhaps when you apply for a job. If the product does not reflect well on you, perhaps it should have.

Reference Books

Every writer needs a good up-to-date English dictionary and a thesaurus. Other reference books that may be of help are:

Usage

Bernstein, T M (1965). *The Careful Writer: A Modern Guide to English Usage*. Atheneum Publishers, New York.

Fowler, H W and Gowers, E (1983). *A Dictionary of Modern English Usage*. Oxford University Press, Oxford and New York.

"How to" Books

Baker, S (1966). *The Complete Stylist*. Cros. Y. Crowell Co., New York.

Graves, R and Hodge, A (1966*). The Reader over your Shoulder: A Handbook for Writers of English Prose.* Collier Books, New York.

Lambuth, D (1964). *The Golden Book on Writing*. Viking Press, New York.

Strunk, W Jr. and White, E B (1979). *The Elements of Style*. 3rd edition, MacMillan Co., New York.

Writing Reports

Gaum, C G, Graves, H F and Hoffman, L S S (1953). *Report Writing*. Prentice-Hall, New York.

Howard, K and Sharp, J A (1987). *The Management of a Student Research Project*. Gower, Aldershot.

Kapp, R O (1948). *The Presentation of Technical Information*. Constable, London.

Trelease, S F (1969). *How to Write Scientific and Technical Papers*. M.I.T. Press, Cambrige, Mass..

Tufte, E R (1983). *The Visual Display of Quantitative Information*. Graphics Press, Connecticut.

Williams, G E (1948). *Technical Literature: It's Preparation and Presentation*. Allen and Unwin, London.

Annotated Bibliography

Little has been written by mathematicians about writing and speaking, so when something is found it is usually of special interest and help. Therefore the following books and articles by mathematicians are strongly recommended.

Halmos, P R (1983). *Selecta: Expository Writing*. Springer-Verlag, New York.

Edited by Donald E Sarason and Leonard Gillman. This book includes the essay on writing mathematics, also published by the American Mathematical Society in 1973, (see the entry below). The book also includes essays by Halmos on how to talk mathematics and what to publish, and the teaching of problem solving, as well as many other interviews and talks and essays of general interest to mathematicians such as the thrills of abstraction, and applied mathematics is bad mathematics. This book is available in the University of Wollongong Library, first floor, at 510.208.

Steenrod, N E, Halmos, P R, Schiffer, M M and Dieudonne, J R (1973). *How to Write Mathematics*. American Mathematical Society, U.S.A. Reprinted with corrections 1981.

This book comprises essays from each of the four authors on how to write books and papers on mathematics. Notation, punctuation of symbolic sentences, the need for constant rewriting to shape the parts into a coherent whole, careful use of mathematical terms, and the two parts of a mathematical presentation: the formal structure and the informal material are all discussed here. This is a paperback available in the University of Wollongong Library, first floor, at 808.06651/2.

The following books are available in the University of Wollongong Library, the bookshop at the University (and could perhaps be browsed there by fast readers), or from staff in the School of Mathematics and Applied Statistics.

Anderson, J, Durston, B H and Poole, M. (1970). *Thesis and Assignment Writing*. John Wiley and Sons, Australia.

The 12 chapters in this book cover the planning of written assignments and theses, drafting, general format, use of quotations and footnotes, the preparation of tables and figures, appendices and referencing, and editing and evaluating the final product. The planning process involved is illustrated with a story about a student's piece of scholarly writing. This is a paperback available in the University of Wollongong Library, first floor, at 808.02/43 (2 copies) and the 1991 reprint from the Bookshop.

Barrass, R (1978). *Scientists Must Write: A guide to better writing for scientists, engineers and students*. Chapman and Hall, London.

The 14 chapters include discussion on all the ways in which writing is important to scientists, putting thoughts into words, writing so as to help the reader, use of numbers, the art and use of illustrations, effective reading, and preparing and delivering a talk. This is a paperback available in the University of Wollongong Library, first floor, at 808.0665021/1.

Barzun, J and Graff, H F. (1977). *The Modern Researcher*. Harcourt Brace Jovanovich, New York, 3rd edition.

Although it may appear as if this is a book for the history student, there is much of value for the mathematics and statistics student in the chapters on writing, and the sections "Speaking What One Knows" and "Afterword: A Discipline for Work". The paperback and hardcover versions are available in the University of Wollongong Library, first floor, at 907.2/19 (several copies).

Beasley, V (1986). *Eureka! or How to be a Successful Student*. Health and Counselling Service, Flinders University, Australia.

This book is written especially for new tertiary students. It is a how to learn book and not a how to study book. It explains how to use lectures, study groups, tutorials and library catalogues, and how to skim read and draft essays. It provides advice on examinations and obtaining feedback on assignments. The sections on writing laboratory reports, coping with writer's block, writing the essay introduction and oral presentations would be of especial interest to later year undergraduates. This paperback is available in the University of Wollongong Library, first floor, at 371.302812/2 (several copies).

Betts, K and Seitz, A (1986). *Writing Essays in the Social Sciences*. Thomas Nelson, Australia. Reprinted 1991.

The chatty style, cartoons and list of references (including references on non-sexist writing) may attract mathematicians to this book. Conceptual and practical advice is offered on subjects such as use of tables and writer's block. This is a paperback available in the University of Wollongong Library, first floor, at 808.042/59 (two copies), or the Bookshop.

Clanchy, J and Ballard, B (1991). *Essay Writing for Students - A practical guide*. Longman Cheshire, Australia.

This readable book discusses the first drafts, editing, assessment and follow up and mentions some of the dangers of word processing. This is a paperback available in the University of Wollongong Library, first floor, at 808.042/16 (three copies) or the Bookshop.

Day, R A (1988). *How to Write and Publish a Scientific Paper*. Cambridge University Press, 3rd edition.

This book has 30 short chapters including material on how to write a conference paper, how to write a thesis, how to present a paper orally, how to write a book review, where and how to submit a manuscript, and how to prepare a poster. Lists are provided on: abbreviations, common errors in style and spelling, and expressions to avoid. This is a paperback available in the University of Wollongong Library, first floor, at 808.066/17, and can probably also be ordered from the Bookshop.

Howard, K and Sharp, J A (1987). *The Management of a Student Research Project*. Gower, Aldershot, Great Britain.

The authors have experience as supervisors and examiners of social science students' undergraduate projects and doctoral and master's theses. Their personal backgrounds are in engineering and mathematics. The eight chapters include discussion on types of research, selecting and justifying a research topic, selecting and working with a supervisor, planning the research project, literature searching, data analysis and gathering, coping with problems which may arise, word processing and editing, report structure and preparing for an oral examination. They also provide a selected bibliography on data analysis and research methodology, a general bibliography, and an index. The 1983 hardcover edition is available in the University of Wollongong Library, first floor, at 378.176/1. The 1987 edition can still be ordered from the Bookshop.

Lindsay, D (1984). *A Guide to Scientific Writing: A Manual for Students and Research Workers*. Longman Cheshire, Australia.

This book explains how to write economically and enjoyably. The five short chapters include: drafting and editing for a journal paper, writing a review, preparing a seminar or conference paper, student practicals and reviews, and the thesis. This is a paperback available in the University of Wollongong Library, first floor, at 808.0665/5, or from the Bookshop.

Phillips, E and Pugh, D S (1987). *How to Get a PhD - Managing the Peaks and Troughs of Research*. Open University Press, Milton Keynes, Great Britain.

The authors have researched PhD education in Great Britain and also have experience in supervising and designing doctoral programmes. Both postgraduate students and their supervisors should obtain insights into the PhD research learning process from this book. The twelve chapters include discussion on becoming a postgraduate student, how to do research, how to manage your supervisor, how to supervise, formal procedures, common difficulties in completing the thesis, and the limitations of the present system. An index and references are included. The 1987 hardcover edition is available in the University of Wollongong Library, first floor, at 378.24/2. Paperback copies can be ordered from the publisher via the Bookshop.

Strunk, W Jr. and White, E B (1979). *The Elements of Style*. 3rd edition, MacMillan Co., New York.

This short book tells you how to write good plain English that will be clearly understood. It provides both instructions on established and acceptable English usage and advice for writers on developing their own personal style. Clear rules of English usage, principles of composition, and lists of words and expressions commonly misused, along with their correct meaning, are concisely presented. Attitudes of mind necessary for the creation of a good personal style are discussed. This is available in the University of Wollongong Library, first floor, at 808/51 and from the Reserve.

Watson, G (1987). *Writing a Thesis - a guide to long essays and dissertations*. Longman, London and New York.

This paperback is mainly addressed to students of history and literature in Great Britain. However all students will find it contains interesting and helpful discussion on the wider motives of scholarship and some of its common hopes and fears. The author explains how a thesis is very different to an essay and discusses the general approach to a thesis in part one, and then advises on techniques in part two. The first three chapters discuss: why scholars write, am I stupid enough?, and the fear of eccentricity, and are especially useful to students lacking confidence in their abilities and place in the world of research. Chapter 7, the writing bloc, gives aids to getting started. Of general interest too are the chapters on editing, teaching and being taught (which discusses the role of the supervisor), classes and seminars, and publishing. Each of the 21 chapters is often less than three or four pages long and quotations from a wide variety of sources are used as illustration. Suggestions for further readings are provided. The Dewey reference is 808.02, and some libraries may have it or it could be ordered from a bookshop.