SOLENT M202 NEWSLETTER No. 4 16th May 1973

Editor: (Mrs.) Marion Stubbs

AN ECONOMIC VIEW OF MATHEMATICS - contributed by Alan Nicol

Fellow M202 sufferers who would like a little light relief (?) next year might like to consider D222 Microeconomics. Although not primarily mathematically based, it occurred to me that it might be of interest to those who have taken M201 and would like to see some maths applied in a different field. I have, so far, seen only about half of the course units, but I would mention a few of the relevant topics.

The set book ('Introduction to modern microeconomics' - Lancaster) contains a substantial section of mathematical notes, mainly covering the applications of calculus to economic theory. Also recommended is a book called 'Mathematics for modern economics'- R. Morley. (I have a copy which can be examined.) This book is based on set theory, etc. (Oh dear!)

Among the units there is a section on linear programming and convex sets, applied to the theory of costs and production. There are also some computer exercises. Among the reading supplied is a copy of a well-known (and excellent) article by Robert Dorfman - 'Mathematical or linear programming.'

The other topic I have seen so far is a section on the application of Games Theory to oligopoly.

I would be delighted to show any of the above mentioned literature to any interested student.

PROBLEM CORNER. No. 4

What is the maximum number of pieces you can get with three simultaneous cuts through one doughnut?
You may test with actual doughnuts, but results may vary if the hole is not perfectly round.
Hint: use steel skewers during technical tests.

Further problem: What is the optimum proportion of the diameter of the doughnut's hole to the diameter of its cross section in order to obtain the LARGEST POSSIBLE SMALLEST PIECE ?

(From: Gardner, Martin. More mathematical puzzles and diversions from 'Scientific American'. Bell, 1963)

SUMMER SCHOOLS 1973

Lift wanted to K6 please. Contact Tony Brooks

Lift possibly wanted to K7 please, but only if able to offer door-to-door service! (Once on public transport, may as well stay there.) Contact Marion Stubbs.

SUMMER SCHOOLS 1974

Kingsgate College, Broadstairs is advertising in *Sesame* (April) offering weekend and midweek courses for OU Humanities and Social Science students. They have promised to look into the possibility of including mathematics in the 1974 programme, since we now have no Summer School provision for the half-credit courses.

I found one student who went in 1972. She pronounced it excellent. The 1973 prospectuses make interesting reading both regarding course content and prices, and it is worth while to send for a set. Presumably it would be even better if you let them know if you will be interested in 1974 mathematics - or will you?

SOUSU

I have now become Secretary of the Solent OU Students Union and will be pleased to send information on SOUSU to any interested reader. It may be pertinent to mention that 'union' should be understood as a synonym for 'association', more as in set theory than in any TUC sense. SOUSU is an independent local organisation, providing services for local students in a way which we feel cannot be supplied by a large, impersonal national association. There is, however, no reason why students should not belong to both SOUSU and NOUSA - in fact I do.

MATHEMATICAL SPECTRUM

The attached sample did not arrive unsolicited! Mathematical Spectrum is a really interesting periodical. It has been advertising in Sesame. The latest issue contained a questionnaire asking for readers' views on what they wanted for the future, and any suggestions on how to extend readership to students of mathematics. I volunteered to circulate a sample offprint with this newsletter, and it is hoped that you will all be willing to risk 50p. for a subscription. As a satisfied reader, I will risk a guarantee that it will not be wasted. (It even gave me the answer to one CMA question.)

M.O.U.T.H.S.

A complete list of all known names, addresses and telephone numbers of M202 students is attached. Anyone else ? All have volunteered to have their addresses revealed, so presumably want inter-student contact. Don't, wait until you have a special problem - you'll feel a lot more cheerful after any sort of chat with a fellow-victim.

FINAL REMINDER

Monday May 21st. 7.30 pm. Bay Tree Inn, 10 New Road, Southampton. All the way from Walton Hall - the great guy who promises you that you're doing well to get 4/10 - JOHN MASON in person. Rally round, folks. We know you are busy with TMAs, but let them wait for one more day.

SOLUTION TO PROBLEM CORNER No. 3 - Geoffrey Yates

So many mathematical problems are either trivial or impossible! Referring to the diagram on page 4, we can see that if the two given circles are equal, sc = r, and in triangle ASC,$(r + x)^2 = r^2 + (r - x)^2$ (Pythagoras again!) so that x = r/4. Hence, all that is required is to obtain the distance r/4 by bisecting r twice, adding to obtain 5r/4, then taking A and B in turn as centre, striking arcs of radius 5r/4, the intersection giving the required centre C. The small circle of radius r/4 can then be inscribed.

If the two circles are not equal, then if N is the foot of the perpendicular from B to AP, we have:-

In triangle ABN, $(r + s)^2 = (r - s)^2 + (p + q)^2$
In triangle ACS, $(r + x)^2 = (r - x)^2 + p^2$
In triangle BCT, $(s + x)^2 = (s - x)^2 + q^2$
Therefore, $4rs = (p + q)^2$
$4rx = p^2$
$4sx = q^2$

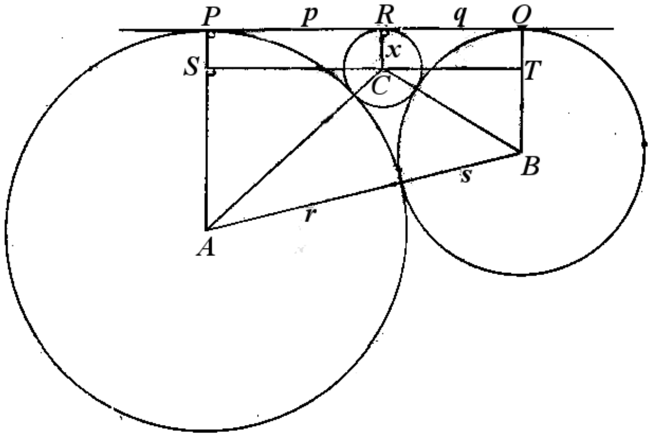
It follows that $4rs = (\sqrt{(4rx)} + \sqrt{(4sx)})^2$, i.e. $x = rs/(\sqrt{r} + \sqrt{s})^2$

At this point, I find I have to use the graduations on the ruler and a set of log tables - but is there a way with just a straight edge and compasses?

NEWSLETTER DISTRIBUTION

The experimental period of this Newsletter is now over, and it is hoped that readers will want more! However, it is not fair to burden Dr. Elliott with the permanent job of unpaid postman, and in any case, the OU might start to object to increased postage on returned TMAs due to the additional weight, so future Newsletters will be issued by hand at both the Bournemouth and Fareham tutorials, as hitherto, but those not present will only be able to have a copy if they have supplied a set of stamped addressed envelopes (minimum size 9" x 4") to the editorial homestead. (Anonymity will be strictly preserved if so requested.) How many envelopes you send is a personal decision, but any not used will be returned, so there is nothing to lose.

There should be five more Newsletters, all being well - that is, assuming contributions and news of some sort continue to roll in.



<u>SELF-HELP GROUPS FOR STUDENTS OF MATHEMATICS</u> – Geoffrey Yates

Surely by now most students are feeling the need to become more fluent in their mathematics. This necessitates familiarisation by means of group discussion. To this end, a few of us have agreed that at least one of us will go to Southampton College of Technology every Wednesday evening, 7-9 pm (except holidays). You will have noted in the BA Handbook that the OU expects students to discuss their course work and assignments, so do come and discuss them.

On every term-time Wednesday evening there will always be somebody familiar with M100, M201 and M202 at Southampton College of Technology.

(and barring SOUSU meetings, or absence through holidays or summer schools, you can use Marion Stubbs's house for the same purpose during the College vacations, every Wednesday evening, 7 - midnight, but better ring me first to check. Ed.)

[Ladies are Mrs. unless otherwise stated.]

MATHEMATICAL SPECTRUM (*MS*) is a magazine for the instruction and entertainment of students in schools, colleges and universities. It was founded in 1967 by a small group of mathematical enthusiasts whose aim was to help students grasp the main ideas of mathematics and to encourage elementary research. While there is a great deal of mathematical teaching in educational institutions, it was felt that students often missed the main ideas of mathematics - its spirit, as against its techniques. It was precisely this spirit which the magazine was intended to foster.

When the Organising Committee for *MS* was formed, it was surprised to find that there were no established facts about potential demand on which to base its planning. It was therefore agreed that, with the assistance of Oxford University Press, 2,000 copies of a preliminary announcement together with a mockup of MS should be sent out to 1,100 schools and other institutions in Britain, the U.S.A. and Australia, The mockup contained four short articles

The irrationality of π
Meteoric dust and noctilucent clouds,
The spread of an epidemic, and
G. H. Hardy and British mathematics.

These were similar in style and content to articles projected for the new magazine. A few problems and their solutions were also included. A short questionnaire was mailed out to readers for information on the likely number of school and university subscribers, as well as vocational advice, information on university courses, and mathematical problems.

The response to the questionnaire was excellent; replies from students and teachers confirmed the Committee's belief that the publication of MS would be a worthwhile venture. At this stage in 1968, the Committee set out to commission papers from practising mathematicians on various mathematical topics. These included subjects in pure and applied mathematics, statistics and biomathematics, operational research and computing science. Correspondence was also encouraged, and it was made clear to readers that their active participation was an important function of the magazine. What the Editors hoped for was active feedback which would help to make *MS* a periodical tuned into the wavelength of its readers.

Contributors to the first five volumes, issued f r o m 1968 t o 1973, have ranged from world-famous mathematicians to students, and their articles have covered practically every branch of mathematics. Many articles conclude with suggestions for further reading to help the independent worker who wishes to delve more deeply into an interesting topic. Each issue contains reviews of books likely to interest students. Also included are problems to which readers are invited to submit solutions, the best of which are published later. *MS* is published by the Applied Probability Trust in annual volumes appearing in the academic year. Volume 6 No.l will appear in September 1973, and Vol. 6 No. 2 in March 1974. The price is £0.50 per volume, with a discount of 10% on orders for five or more volumes. Orders for Volume 6, and enquiries concerning earlier volumes, should be sent to The Editor - Mathematical Spectrum, Hicks Building, The University, Sheffield S3 7RK. A typical article which appeared in Volume 5 No.2 is to be found overleaf.

Calculating Square Roots of Perfect Square Numbers by Inspection

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P. N. MEHTA

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A number of approaches are known for finding the square roots of numbers. In this article we explain how to find the square root of a perfect square number by the method of inspection.

Considering the squares of numbers from 1 to 9, it is seen from Table 1 that the digit in the unit place for the square numbers is symmetrically repeated in the order 1, 4, 9, 6, 5, 6, 9, 4, 1.

TABLE 1

Number	1	2	3	4	5	6	7	8	9
Square	1	4	9	16	25	36	49	64	81

Thus, for a perfect square number only one of 1, 4, 9, 6, 5, or 0 occurs in the unit place.

A square number with 1 in the unit p!ace will have either 1 or 9 in the unit place of its square root. More generally, if a_1 be the digit in the unit place of the square-number, there will be two possible digits, say a and b, in the unit place of its square root. Let $b \geq a$. We show the possible digits, a and b, corresponding to a_1 in the unit place of the square number in Table 2.

TABLE 2

a_1	1	4	9	6	5	0
a	1	2	3	4	5	0
b	9	8	7	6	5	0

If $a_1 = 9$, a and b will be respectively 3 and 7, but when $a_1 = 5$ or 0, $a = b$ and each will be equal to 5 or 0 according to whether a_1 is 5 or 0.

Let any perfect square number A be expressed in the form

$$A = a_3t^2 + a^2t + a_1,$$

where $t = 10$ and a_1, a_2 are digits but a_3 may be any number whatever. Thus, a_1, a_2 will be the digits in the units place and tens place respectively and a_3 will be the number of 100's in A.

Corresponding to a_1 in the unit place of a square number A, $\sqrt{A}$ will be equal to $10n + a$ or $10n + b$, where n is so chosen that

$$n^2 \leq a_3 < (n + 1)^2.$$

To determine a or b consider the two inequalities

$$a_3 - n^2 < n \tag{1}$$

and

$$(n + 1)^2 - a_3 \leq (\mathrm{n} + 1). \tag{2}$$

We see that either

$$a_3 < n(n + 1) \tag{3}$$

or

$$a_3 \geq n(n + 1). \tag{4}$$

If n satisfies the inequality (3)

$$\sqrt{A} = 10n + a,$$

while if n satisfies the inequality (4)

$$\sqrt{A} = 10n + b.$$

Illustrative examples

(i) Find the square root of 110224.

Let $110224 = 1102t^2 + 2t + 4$, where $t = 10$; then $a_3 = 1102$, $a_2 = 2$ and $a_1 = 4$. As $a_1 = 4$, we have $a = 2$ and $b = 8$. Now

$$n^3 \leq a_3 < (n + 1)^2$$

leads to

$$(33)^2 < 1102 < (34)^2 ,$$

whence $n = 33$ and $n(n + 1) = 33 \times 34 = 1122$. Further, the inequality

$$1102 < 33(33 + 1)$$

holds, or $a_3 < n(n + 1)$ is satisfied. Hence $a = 2$ is the correct digit in the unit place and

$$\sqrt{110224} = 10 \times 33 + 2 = 332.$$

(ii) Find the square root of 1296.

In this example the inequality (4) is satisfied with the equality sign, so that $\sqrt{1296} = 10\mathrm{n} + \mathrm{b} = 36$.

(iii) Find the square root of 65536.

Here also the inequality (4) is true and $\sqrt{65536} = 256$.

(iv) Find the square root of 93025.

In this case also the inequality (4) holds, again with the equality sign. As $a = b = 5$, we obtain $\sqrt{93025} = 10 \times 30 + 5 = 305$.