M500

17

INVERSION OFHILBERT MATRICES

Hilbert matrices provide elegant examples of ill-conditioning in M100 and M201, but the need to invert them does sometimes arise in other contexts.

Define the kth Hilbert matrix (k = 0,1,2,...) as having $(i+j+k-1)^{-1}$ as its (i, j)th element, i.e. the element in its ith row and j^{th} column (i,j = 1,2,3,...). It can extend indefinitely 'to the right' and 'downwards', but inversion is considered only for the leading n x n sub-matrix (n = 1,2,3,...). Since the values of i and j can be interchanged without altering the value of an element, these sub-matrices are symmetrical.

There is a theorem (see e.g. Ref. 1) that a square matrix A in which all the leading square sub-matrices are non-singular can be resolved into the product LDU of a lower-triangular matrix L, a diagonal matrix D, and an upper-triangular matrix U.

The resolution is not unique; if the ith column of L be divided by non-zero x_i and the i-th row of U be divided by non-zero y_i, the value of A is unchanged if also the i-th diagonal element of D be multiplied by $x_i y_i$. If A be symmetrical the resolution can have the form LDL^T where L^T is the transpose of L. We use this form, which obviously has inverse $A^{-1} = (L^T)^{-1} D^{-1} L^{-1}$, and note that we may choose the elements of D to suit our purposes.

With A_k the leading n x n sub-matrix of the kth Hilbert matrix and D_k the diagonal matrix with elements those of the main diagonal of A_k, the ith diagonal element of D_k^{-1} is 2i +k−1. Then the (i,j)th element of L_k^{-1} is found to be

$$(-1)^{i+j} \binom{2j + k - 2}{j - 1} \binom{i + j + k - 2}{i - j} \qquad (1)$$

the proof being a rather lengthy and tedious matter of summations of products of binomial coefficients. In evaluating A_k^{-1} as $(L_k^T)^{-1} D_k^{-1} L_k^{-1}$, n now makes an explicit appearance as the upper limit of summations entailed in evaluating the elements of A_k^{-1}.

The matrix L_k^{-1} with elements given by (1) has the following property:

post-multiply it by the column vector $[x^{j-1}]^T$ (j = 1,2,...) and one obtains a column vector of polynomials $[P_{j-1}(x)]^T$, which are mutually orthogonal on the interval [0, 1] under the inner product

$$\int_0^1 P_r(x) . P_s(x) . x^k \, dx$$

In fact for k = 0 they are simply the orthogonal system of Legendre polynomials when the 'usual' system is shifted to the interval 0,1.

This connection between Hilbert matrices and orthogonal polynomial systems is not mentioned in such standard works on orthogonal polynomials as Refs. 2,3,4. It seems unlikely that it has not been noticed before, and the writer would be glad to be sent any relevant reference.

References:

1.   FOX, L. J. Royal Statistical Society, Series B, 1950, **12**, 120

2.   SZEGO, G. Orthogonal polynomials. Amer. Math. Soc. Coll. Publications, 1959

3.   FREUD, G. Orthogonal polynomials. Pergamon Press, 1971

4.   ERDELYI, A. and others. Higher transcendental functions, McGraw-Hill, 1953

Percy Sillitto West Malvern,WR 14 4BH

MAN - POWERED FLIGHT

When I first became interested in man-powered flight, data was hard to come by, or impossible to obtain. Nowadays, thanks to D.R. White writing in the Journal of the Royal Aeronautical Society, August 1960, the power output of a fit young man, under various conditions, is obtainable and has proved reliable.

White calculates the steady output of a fit young man to be 0.4 H.P. Sherwin, in his book 'Man-powered flight', calculates a required 0.34 H.P. in steady flight, climbing to 0.566 H.P. when the machine climbs at an angle of 1 degree. The machine in question being a design study example, hence untried.

Sherwin, in studies (design) of two well-known man-power machines - the SUMPAC and the PUFFIN 1 - calculates a steady output of 0.425 H.P. requirement. Both of these machines have flown and crashed. The combination of pilot and power unit has proved too much for one man. Conclusion: overloading the pilot creates hazards for both man and machine.

I think the majority of readers will agree with Sherwin that the conversion of man-power energy to mechanical is most efficiently done by a cycling action, this being the most flexible, also when used in combination with hand cranking I would suggest that it is the most efficient.

Please note that I have refrained from specifying pedal cycling. There is a reason for this which ties in with the lack of props shown in my sketches in M500/16 of a 5-man-powered machine.

I have made it clear to our Editor that what I propose is a feasibility study of at least one man-powered aircraft where everyone can join in using their newly-acquired mathematical knowledge, their experience and their imagination.

George Dingley, Brierley Hill DY5 2JS

Ed: I heard on 29th October 74 from George's sister-in-law, who writes: "He has had two slight seizures and has migraine headaches almost constantly, but he will write to you as soon as he is better, which I hope will be soon". We hope so, too - best wishes for a rapid recovery, George.

THE ROTTEN EGG

Martin, aged 7, who visits me rather too frequently for my peace of mind, perhaps because his father is away from home, said to me a few days ago: "The Open University is that shield with the hole in it, isn't it?" I had to agree. Perceptive little lad, you might think. Did he really see my defensive posture through the hole in my shield? Has the OU really got a hole in it?

At least, one might say, with a hole that size one can see through it fairly clearly, but one feels that it is also a temptation to those opposed to 'us' for one reason or another to regard the thing as a target. In this fairground game, which rotting cabbages do in fact penetrate the hole in our shield? I think the most obvious one is that teachers with a nice string of bonus credits only have to get another three to add a large bonus to both their salary and their standing in the profession. It may be a soft missile, but I'm not too sure. Then a big old turnip comes through: there seem to be plenty of fat cat jobs in the 'Education business' to which fat intellectual cats gravitate. The OU has provided another chance to get at the cream. In Southampton the Study Centre (for want of a better name) is situated inside one cream carton and next door to another.

The rotten egg which I want to fling through the hole is that the Foundation year makes virtually no systematic attempt to analyse the student's problems and advantages. To do so some kind of examination or diagnosis is needed straight away. Hence my letter March 74, Sesame, p. 2. It seems to me very wasteful (a) to expect students to sink or swim alone and (b) to scream for help, if it occurs to them at that time, for their counsellor to practise his life-saving technique when, with a bit of forethought, new students and students new to particular areas of study might be helped to learn to swim rather than being dropped into hazardous waters just to see if they can swim. It is so like the education system as a whole, in which the model is accept/reject like a sieve, rather than respond to needs like a horticulturalist, or a parent, come to that.

It is all very well saying that by the time one is a university student one ought to have found out how to make the best use of one's abilities, but some of us believed

that the OU night help us to discover how to use our abilities which were not valued in the school system of 25 years ago and naybe not today either, but we find that Course writers, lecturers, staff-tutors, tutors and counsellors all tend to be much more like the class-room teachers of our youth than any of the men and women we meet in our jobs and our everyday life.   What is valued mostly is the ability to read what they have written and remember what they said first and then attempt to make use of it to formulate our own hypothesis, though the latter is not regarded as being of any importance since we are only students.   'Student-centredness' is all right for infants and post-graduates, but not for those in between the two.

I don't think my rotten egg went clean through the hole, but it may have broken on the edge and spattered a little on the OU 'system' behind its shield of academic integrity.

<div align="right">Peter Arnold, Alderney, Channel Islands</div>

Peter has been receiving M500 since its inception in 1973, but is, in fact an B- and D-Faculty student.   Recently, like Dr. Ketley, he has indicated that it is a waste of time to send it to him.   Be writes: 'Do I understand you correctly - M500 is packaging for MOUTHS.   It is not really about Maths at all.   It just has that appearance?!   If there are any MOUTHS doing E383 or E221 their non-maths writings don't often appear in the newsletter. Their' maths writings are all totally above my head, or at any rate don't exactly raise my pulse rate.' Far from being 'remote', Peter frequently writes to a vast circle of friends. to Walton Hall staff, and to almost any extant OU publication! (The above first appeared in the Solent OU Society News Sheet No. 6, June 1974). Members of Beth Taylor's CHANNELS must know him well, but he has not yet officially joined MOUTHS. However, his address is no secret, and anyone wanting a debate on (a) the virtues, if any, of studying mathematics at all and (b) 'Pure' versus 'Applied' - if either still exist - will find him a stimulating correspondent. He is renowned, professionally, for making ceramic glazes from the Alderney beaches, and explains that this is partly occasioned by the total lack of trees on Alderney.

Incidentally, the 'fat cream carton' next to the Southampton Study Centre (for want of a better name) is the one that gave your ed. a job!! (It's really a skimmed-milk product, though, and doesn't even boast an electronic stencil-cutter in its equipment. Hence this particular ed's problems ref. reproductions).

BOOKS AND UNITS WANTED

Second-hand M202 SET BOOKS wanted by Martin Mann, who is off to the U.S.A. and wants to take the whole course with him. (He already has the units). Offers to him at Kini Whare, ...

<div align="center">++++++</div>

Wanted: Units T100 13/14: The heart of the computer/Computer systems - preparatory reading for TM221. What offers, please? Willing to buy or borrow. Marion Stubbs (A001...!)

<div align="center">+++++++</div>

Fantastic Bargain -

You may remember me as the crazy fellow who bought the M201 and M202 correspondence texts in advance, in order to catch up on studying before I ran into the heavy weather (literally as well as figuratively) of farming in the summer and autumn.

Would you please tell the readers of M500 that I've got the set of M201 units for sale - I mean the new, unused ones that came in the post during the course - for £12 plus postage.

Hugh Tassell; Marden, Kent

(Hard-of-Hearing student - please raise voice clearly when telephoning)

SOLUTIONS

14. 1 Collineations - Sue Davies

I agree with Roger Claxton that G is a group of order168.

<u>Subgroups</u>

Obviously the rotations and relctions of the entire triangle form a subgroup » S, , order 6. The rotations on their own give a subgroup of order -> 3 and the reflections give subgroups of order 2. Keeping one point fixed allows

2l± permutations for remaining 6 points which gives a subgroup of order 2h» There are obviously 7 such subgroups.

Keeping all 3 points on 1 line fixed gives a subgroup of order U. Again there are 7 such subgroups. These were the only obvious subgroups which occurred to me, but according to Sylow, since

$$o(G) = 168 = 2^3 \times 3 \times 7$$

we should have 2-Sylow subgroups of order 8 and 7-Sylow subgroups of order 7. Order 7 suggests complete permutations.

Consider a complete permutation p, e. g. (1642537).

Then the group generated by p − {e, p, p^2, ..., p^6} is a subgroup of G of order 7.

There are 48 complete permutations in G (by a similar argument to the one used by Roger Claxton for o(G). Since 6 are required for each subgroup, there are 8 subgroups of order 7 (in accordance with Sylow 1 + 7k).

The subgroups of order 8 are obtained by fixing one point and one of its radials, but allowing the other two points

on the radial to be interchanged. Since these two points can be placed in 2 ways and the remaining 4 points in 4 ways this gives a subgroup of order 8. There are 7 points, each with 3 radials, which gives 21 such subgroups, (Sylow 1 + 2k).

There are also the subgroups formed by fixing 1 line but arranging the 3 points on it in any position. These 3 points can be arranged in 6 ways and the other 4 points in 4 ways. This gives 7 subgroups of order 24.

Normal subgroups?

Consider a permutation in the subgroup S_3, s = (23)(56). Take any other permutation g $\in$ G, e.g. g = (37)(54) then g s g^{-1} = (37)(54)(23)(56)(37)(54) = (27)(46) $\notin$ S_3. Hence, S_3 is not normal in G.

A similar calculation shows that none of the above subgroups are normal in G.

Conjugacy classes

2 permutations in S_n are conjugate iff they have the same cycle decomposition. Hence in G $\subset$ S_7, 2 permutations are conjugate only if they have the same cycle decomposition (but not necessarily if!)

There are 5 different cycle decompositions in G:

$$\{2, 2\} , \{3, 3J , \{2, 4\}, \{7\} \text{ and e (identity perm.)}$$

By similar arguments to Roger Claxton's for o(G):-

there are   21 permutations with cycle decomposition   {2, 2}
            56   "   "   "   "   {3, 3}
            42   "   "   "   "   {2, 4}
            48 complete permutations

A complete permutation p commutes only with its powers, i.e. o(N(p)) = 7 hence o(C(p)) = 168/7 = 24. Hence there are 2 conjugacy classes of complete permutations.

Similarly a {2, 2} permutation commutes with 8 elements of G. Hence the order of its conjugacy classes is 21, all {2, 2} permutations are in the same congugacy class.

A {3, 3} permutation commutes with 3 elements of G, order of conjugacy class is 56, all {3, 3} permutations are in the same conjugacy class. Similarly, all {2, 4} permutations are in the same conjugacy class (order 42). Obviously e is conjugate only to itself.

Hence there are 6 conjugacy classes of G of order 1 , 21 , 24, 24, 42, 56.

If n $\in$ N - a normal subgroup of G - then

$$g \, n \, g^{-1} \in N \;\; \forall \, g \in G$$

i.e. all members of conjugacy class of n $\in$ N.

Hence N consists of entire conjugacy classes of G. But o(N) / o(G) and no sum of conjugacy classes (including e) divides 168. Hence G has no normal subgroups.

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15. 4 Rabbits - Hugh Mclntyre

If dog knows that rabbit will run at constant velocity, them: Case (a) - Dog will catch rabbit when rabbit has gone up the y-axis a distance equal to $\sqrt{[u^2/(v^2 - u^2)]}$, u and t as given. No great value in method of proof. Merely Pythagoras and similar triangles.

 Case (b) - This is straightforward if we have an intelligent dog who runs pointing at the rabbit. A typical situation is as drawn, where the dots are the trace of the dog's previous positions, and the final position is shown. For a start, since OB = 1, AF/1 = v/u. So AF = v/u. If (x,y) are the coordinates of F, then: since BA = $\sqrt{2}$, $\sqrt{2}/1$ = AF/(1-x) = AF/y, (similar triangles). From these we get: x = 1 + v/$\sqrt{2}$ u, and y = v/ $\sqrt{2}$ u. If (x,y) = (0,1) we get the condition of part (a), and v = $\sqrt{2}$ u. Interestingly enough, if we put this into the expression for part (a) we get: y = $\sqrt{u^2/2u^2 - u^2}$ = 1, as expected. QED.
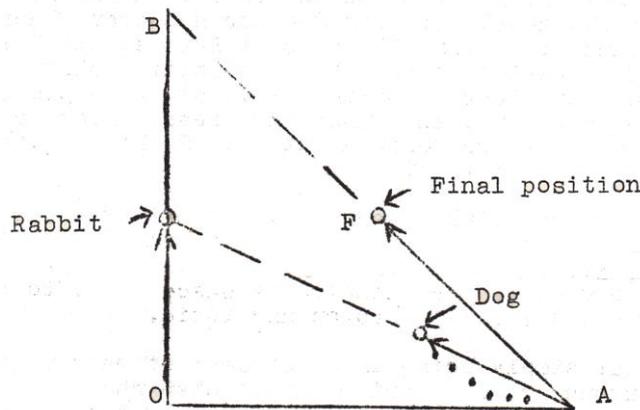
Ed: Peter Hartley's solution,(which is rather differentl) will follow in No. 18 - assuming space permits.

14.3 - Richard Ahrens

Sue Davies appeals for a solution to No. 14 Problem 3. A nice proof can be found in 'Introduction to Geometry' by H.S.M. Coxeter (Wiley), pages 23 to 25.

There is also an interesting historical note about the problem - known as Morley's theorem (Christopher Morley's father) - discovered 1899, 15 years before an elementary proof was published - one proof very similar to the one in Coxeter is due to Roger Penrose (brother of Oliver).

Ref. 15.1 - surely Hugh Mclntyre doesn't really believe that each day we have equal quantities of light and dark? I should have asked the question during the winter.

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16.2 Goat-Grazing

Lytton Jarman has been working on this one for weeks! At the Kingsgate weekend, Dr. Earl pronounced the solution could only be found by numerical methods. Farmers and others might care to make practical experiments? Results to M500, please!

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TO DR KETLEY

Coming in as I did circa M500/9, I missed the early M202-orientated days of M500, so I am unable to form an opinion about what went on then. To Ian Ketley, on the evidence of his piece in No. 15, they were halcyon days - and the elegant applecart has been upset by outsiders of indifferent quality. I make no apology for being a Johnny-come-lately.

Dr. Ketley is faintly patronising. M500 has never struck me as being an affront to anyone's sensibilities. It is surely no part of its function to portray the OU maths student as an upright Gauss-fearing person. Good heavens, if it represents anything, it must be the personal views of its contributors, or the bias of its editor - and the latter is unlikely. I, as a contributor, have absolutely no interest in convincing some nebulous mathematical community at large that I am worthy of their condescension. Anyone who doesn't like me is at liberty to lump me.

We are, most of us, far too busy to find the time to look all over the place for alternative sources of enlightenment. Where else, I but in the OU, should we look for our answers? Where do Dr. Ketley's fulltime students look? The ones at Southampton Univ., I mean. I'd hazard a guess that they have an initial shufti around the mathematical purlieus of Soton Univ., at which place we have all subscribed to their fees. Then they read a book or two. Or write to someone. Or think about it. So how are they different , from us, or we from them?

How naive do you think we are, Dr. Ketley? Books written by the OU staffmen are obviously attractive to us, since it is likely that they will be instantly comprehensible to us. There are, however, no grounds for thinking us susceptible to 'impressions' that they are the final word on any topic.

I agree that simply being an OU student of mathematics doesn't qualify anyone as an expert mathematician who can see how the subject develops. I know of no student of the OU who claims such gifts. Nor, I suspect, does Dr. Ketley. The trouble with strings of qualifications is that it is not easy to find examples satisfying all of them. How about an OU maths student who claims to see how maths develops, but who doesn't deem himself an expert?

Mathematically speaking, the OU hasn't exposed very much? Compared with what? Compared with this writer's pre-OU experience it has exposed a great deal. I left school at 15, sans Highers, Lowers, or any other fashionable bit of paper. That was in 1948, and such oversight did not, then, qualify me as an idiot. Having struggled in the wake of lightning calculators and scientific geniuses of all shapes - sunk in a mire of unexplained terms and dead notation - I dutifully went through the motions of National Certificate maths at evening classes. W.W. Sawyer kept me sane. Then I applied for a grant to study for a maths degree. My interview, conducted by two elderly gentlemen who got into a twist over my 4/6d travelling expenses, was pure Kafka. I did not get the grant. Next, I explored the possibility of doing a London External. Before abandoning this idea I became amazed at the number of people who knew nothing about such things, but who did not recommend it as a course of action. One did not have to be very acute to perceive that the biggest hindrance to taking a degree was the lack of a degree. The rest of the mathematical world, Dr. Ketley, has had ample time, and opportunity, to expose itself to me,

OU maths detractors - where were you before 1971? Knocking on our doors in great numbers, we surmise; offering places at university.

Think on this, Dr. Ketley: M500 is written by and for adults with limited spare time. Our ways are not those of the adolescent who has stepped, as part of an automatic process, from school to super-school, stopping only to pick a subject. We have, most of us, achieved a fair amount in life, and we are now in mathematics because we are masochists. Only a masbchist would work at a technically demanding job and sacrifice every moment of spare time and holidays, and fork out fees for courses, summer school and textbooks - for three to four years... and all this for the disapprobation of the mathematical establishment?

<div align="right">Hugh Mclntyre, Port Glasgow</div>

LOST

2 books of MDT 241 units - 2 different owners. All who did MDT241 at Kingsgate PLEASE check your collection. Return the miscreant units to M. Stubbs, please, for forwarding to their rightful owners.

M500/18 - Christmas issue

VERY LITTLE is now in hand, apart from a numerical crossword from Michael Gregory, Datta on New Algebraic Systems from Old, yet more replies to Dr. Ketley, umpteen problems (some still in the file from 1973!), more on Hoops, and Math-Quotes from Ron Davidson. Are there, for instance, any mathematical ghost-story authors among our readership? Write in rapidly, anyone and everyone - let's have something Christmassy about it. Deadline around December 7th, please, earlier rather than later.

Brickbats (or bouquets) ref. the experimental artistic (?) embellishments to this issue 17 will be welcomed - note how dutifully I've tried, as always, to obey my C-T - but maybe you really prefer inartistic functionality? The size remains foolscap, not A4, however outdated by metrication, because there is an extra inch on foolscap which means 20 extra inches of contents per issue.

You can have one massive 1975 opening MOUTHS list in January or February if you will all now please read and act upon pp.17/18!

<div align="center">+++++++</div>

MATH-O.UOTE - Datta Gumaste

"... Mathematics is capable of an artistic excellence as great as that of music, perhaps greater; not because the pleasure it gives (though very pure) is comparable, either in intensity or in the number of people who feel it, to that of music, but because.it gives in absolute perfection that combination, characteristic of great arts of Godlike freedom, with the sense of inevitable destiny, because, in fact, it constructs an ideal world where everything is perfect and yet true.

<div align="right">Bertrand Russell. 3.4.1902</div>

<div align="center">+++++++</div>

MOUTHS . . .

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Erratum: Sorry - page 2 line 3 should have square (closed) brackets for the interval [0, 1].

- 'a' - sorry, again - p. 5 'Subgroups' line 1 should be 'reflections' [correct in this version].

M231 SURVEY

Here are sam results (printed in M500 by peraission of Prof. D. Hawkbridge of IET) from a survey of M23I students which has been done by the OU's Institute of Educational Technology.   The survey was requested by the M23I course team.   The course team has now been presented with a report covering all the data collected up to early July on Units 3-9, TV programmes 1-6 and radio programmes 1-5.   Data on the remaining units will continue to be collected during the year, using CURF's (see below).   The report to the course team contains a listing of all student comments concerning the units and TV and radio programmes, and the course in general, as well as statistical tables etc.

In the tables below, CURF means 'Course Unit Report Form', and BQ means 'Broadcast Questionnaire'.   All samples were randomly selectedi by computer in February.

CURF

490 students were asked to complete a CURF for each unit from Unit 3 onwards.   30 students found to have withdrawn officially from course, and 16 wrote letters of refusal.   Data for this report processed 10th July,   For Unit 3, 223 forms so far returned (.49% response); for Unit 4, 193 forms (43:);   for Unit 5, 169 forms (37%);   for Unit 7, III forms (24%%);   for Unit 8, 46 forms (10%); for Unit 9, 41 forms (9%).

BQ

For each of TV programmes 1-5, a questionnaire was sent to about 60 students.   All but one of these questionnaires also covered a radio programme.   For TV1and R1, 49 forms returned (87%);   for TV2 and R2, 51 forms (87%); for TV3 and R3, 49 forms (90%);   for TV4, 47 forms (82%); for TV5 and R4, 46 forms   (80%).

DATA FROM CURF's ON UNITS	UNIT 3	UNIT 4	UNIT 5	UNIT 7	UNIT 8	UNIT 9
Total study time (median) in hours (inc. time spent on assignment questions)	16.5	14.8	14.0	15.1	14.0	13.6
Assignment time (mean) in hours	4.6	3.9	3.3	3.8	4.3	3.9
Difficulty score (high=difficult)	98	81	34	61	81.	76
Sections mentioned as being difficult (*= more than 20% ment ioned)	I*,2*, 3,4,7	4,5*, 7	5*,6, 9	4,8	3,6	1,2,5

(26% of students spent over 20 hours on Unit 3, and 9% spent over 30 hours on it).

(Small no. of respondents for Units 8 and 9 so far)

Overall, 48% of students found the SAQs very or fairly difficult, with those In Unit 3 proving most difficult, and those in Unit 5 least difficult. However, 86% found them very or fairly useful. Impression gained from comments on CURF's is that the problems in the problem sections of the units are very time consuming and often extremely difficult.

59% attempted the non-assessed question in TMA 01, and 47% attempted it in TMA 02.

WORK PATTERN (Units 3 - 7)

START	UNIT 3	UNIT 4	UNIT 5	UNIT 7
25% had started on unit by (date)	26 Feb	18 Mar	2 Apr	21 Apr
50% had started on unit by (date)	7 Mar	29 Mar	16 Apr	4 May
75% had started on unit by (date)	13 Mar	14 Apr	30 Apr	18 May
FINISH				
25% had finished unit by (date)	9 Mar	28 Mar	13 Apr	2 May
50% had finished unit by (date)	17 Mar	9 Apr	26 Apr	17 May
75% had finished unit by (date)	27 Mar	27 Apr	14 May	27 May

(Note;   % is of those students in the CURF sample who had sent back forms relating to these units in time for the data to be processed on July I0th 1974).

% WATCHING TV

	TV1	TV2	TV3	TV4	TV5	TV6
BQ	84	78	67	66	58	-
CURF	-	76	67	60	64	63

TV USEFULNESS RATINGS (% of viewers (see below for short version of this)

		TV1	TV2	TV3	TV4	TV5	TV6
Very useful	BQ	17	5	I5	17	19	-
	CURF	-	8	16	20	23	29
Fairly useful	BQ	51	46	76	47	69	-
	CURF	-	30	58	54	59	50
Not very useful	BQ	32	31	3	33	8	-
	CURF	-	36	19	17	17	17
Not useful at all	BQ	0	18	3	0	0	-
	CURF	-	26	4	3	0	4
Don't know	BQ	0	0	3	3	4	-
	CURF	-	1	1	2	0	0

% OF VI EWERS FINDfNG TV PROGS VERY OR FAIRLY USEFUL (short version of above)

BQ	68	51	91	64	88	-
CURF	-	38	74	74	82	79

Note: TV2 is being remade for 1975

Of CURF respondents, for each TV programme (i.e. TV2 - TV6), at least twice as many watched on Monday evening as on Saturday morning. Generally, not many students watched both transmissions, with the exception of TV2, which was watched twice by 25% of the BQ sample and 24% of the CURF sample.

% OF TV VIEWERS USING SAQs IN TV BROADCAST NOTES

BQ	71	67	52	53	35	-
CURF	-	70	70	72	65	79

In all cases, over 80% of those attempting these SAQs found them very or fairly helpful.

MEDIAN TIME SPENT i.e. for those students who spent at least <u>some</u> time on notes)
  ON BROADCAST NOTES   (Inc. SAOs)   AFTER THE TV PROGRAMME IN MINUTES   .

	TVI	TV2	TV3	TV4	TV5	TV6
BQ	23	26	20	32	20	-
CURF	-	26	23	26	27	30

(In each case, about 20% of viewers spent <u>no</u> time on the broadcast notes after the programme).

<u>% LISTENING TO RADIO</u>

	RI	R2	R3	R4	R5
BQ	61	57	45	30	-
CURF	-	61	55	53	57

(Of 25 students interviewed by phone calls after Radio Prog 4, only 6 had heard, or at feast taped, all 4 programmes. 8 had heard no programmes at all, and 3 more had heard only the first one).

About 30% of radio listeners in each case heard the 7.20 am broadcast (Saturday).

About 15-20% of radio listeners tape the programmes.

<u>% OF RADIO LISTENERS FINDING PROGS VERY OR FAIRLY USEFUL</u>

BQ	86	89	90	89	-
CURF	-	86	84	88	-

About 1/3 of those who attempted to do so (90% of listeners) had some difficulty following the radio broadcast notes during the programme (R2 - R4).

MEDIAN TIME SPENT (for those students who spent at least <u>some</u> time) ON RADIO BROADCAST NOTES ANS SAQs AFTER THE PROGRAMME   .

BQ	29	18	26	39	-
CURF	-	23	26	24	-

(In each case, about 15% of listeners spent <u>no</u> tme on the notes after the programme).

MAIL

Needless to say, the Autumn mailbag was rather empty. We have a pageful of new MOUTHS members, mostly attracted by the list of OU societies in Sesame, but only one of them has written to us. Keep writing, folks. Everyone enjoys reading letters!

<u>Russell Brass</u>

I'm afraid I am one of those with no qualifications, and although I managed M100 O.K., I now realise that it was because M100 doesn't have a high mathematical content. I took some rather poor advice to do MST282 this year, and I find this has a very high maths and calculus content, which has proved too much in the time available - I have also been doing M251 and TS282.

So next year it's no more of the hard stuff until I get a bit more background, and I opted for AM289, MDT241 and TM221. Unfortunately the TM221 kits are oversubscribed, and as a 'C' student I'll be at the end of the queue. However, I may be lucky, and I certainly hope so because computing and its spin-offs like artificial intelligence are my current ruling passion. Additionally, technology is really my subject, but a technologist without mathematics has a very poor grasp of his subject.

Didn't poor old Dr. Ian Ketley get a going over in M5OO/16; I hope he realises it's only in fun and that we hold the part-time staff in the highest esteem for bothering with us at all.

AM 289

Graham Flegg wishes to convey his sincere regrets that AM289 has had to be postponed for one year due to his unexpected illness. The only consolation is that the extra time available should ensure that the Course preparation is more thorough and that the inevitable 'snags' and imperfections have been minimized. To all those students who registered for the Course for 1975, he wishes to say "I hope you will be with us in 1976".

Ed: Yes, indeed - just get well soon, Graham. We'll wait. Lytton Jarman (Rugby) and I have been monitoring the calculus-option units, and will be glad to see the 'real' thing. The textbooks are magnificent, and the subject fascinating - but NOT an 'easy option' lads! It's as tough as anything else at 2nd level, though at least one can read it in bed! For those with no pre-fog calculus it is certainly a great experience to be taught Leibniz-notation by the master himself, and integration by substitution by no less than Bernoulli in person.

              If you had opted for AM289 for 1975, please enter it on the M500 application form at the back of this issue. I'm sure lots of the 800 applicants came from M500 readers, and would like to see, for the record.

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PROBLEMS 17

1. What sort of long jump performance Is reasonable from an athlete who can achieve 10.00 sec for 100 metres and 1.9 metre high jump?

    Bob Margolis

2. I work In an office block where all the room numbers and telephone numbers are of four figures.   No number starts with a zero, and the dialling '9' code Is used to get an outside line. My telephone number is an integral multiple (greater than 1) of my room number.   What are my room and telephone numbers?

    Richard Seton-Browne

3. <u>RE SEARCH PROBLEM</u>

    Take a square array of 11 x 11 points.   Choose 22 of the points so that no 3 of them lie on a straight line.

    General problem: Given an n x n array it Is proved that you can put 3n/2 points such that no 3 are co-linear.   It is so far known that such an array can be found for n = 2, 3,..., 10 and for n = l2. Hence the above problem for an n x n array where n = 11.

    (Contributed by Dr. John Earl, Institute of Mathematics, University of Kent, Canterbury - to whom solutions, Ideas, or requests for further details should be sent, please, and not to M500 In the first instance!.   Publication promised for anything which passes Dr. Earlfs scrutiny).

4. 3 fishermen caught a haul of fish and lay down on the shore to sleep. One of them awoke and decided to leave, taking his share of the catch.   He discovered that he could divide the catch into 3 if he threw one fish into the sea.   This he did, and taking his third share he went home. Soon the second fisherman awoke, who, not suspecting that the first one had gone, again began to divide the catch.   Just like the first fisherman, he divided the whole catch Into 3 parts and also discovered that one fish remained over.   Having thrown it away he took his third share of the catch and went home.   The third fisherman went through exactly the same operation, discovering 1h;?i as a result of dividing the catch up into 3 parts there was again one fish left over.   Determine how many fish there were oriolnally, indicating as a result of this the maximum permissible number.

    (Taken from a physics book.)   R.T. Finch

5. The diagram shows two right-angled triangles ABX and ABY which share the same hypotenuse AB.

    AX = 18 units.   BX = 13 units.   AY = 20 units.   BY = 7 units. Find the length of the common hypotenuse AB.
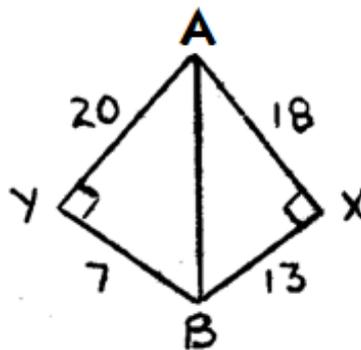
    (From 'Games and Puzzles' No. 27)

REPORT ON KINGSGATE

I thought the Autumn weekend by the Sea for Halves at Kingsgate College Sept. 27/29 was a resounding success, Of course it was not possible to squash in as full a review of the courses as we would have liked, but as much as could be done in the time was done. I feel that after consideration of what was discussed the exchange of ideas and different viewpoints will be very valuable.

Dr. Bryan Morgan, the MDT241 tutor, gave us all a surprise in starting his first session by tipping a large bag of pebbles on the table. This turned out to be a practical experiment to demonstrate the advantages of selecting random samples in order to estimate the mean of a population rather than representative or 'judgement' samples. The experiment led on to discussion of several interesting points and was a great change from the usual isolated pen and paper work.

Nearly everyone was worried about some particular aspect of the course. These points were discussed and clarified at least to some extent. I think that a lot of the value in face-to-face discussion with other students and a tutor is that one tends to get a fresh slant on various aspects of the subject. While this may reveal problems one did not know one had, the general effect is to get a considerable jump forward in understanding. Though it is no doubt tiresome for the tutor if he is not previously very familiar with the course material, this lack of familiarity may be a help in increasing the contrast of his different point of view.

I was very sorry to hear that Kingsgate is closing. I thought we had a comfortable and satisfying weekend which was extremely good both educationally and socially.

Margaret Corbett

Ed: As Margaret says, it was a resounding success, and so nice to meet one's fellow-MOUTHS apart from 48-hours of maths. I seem to have been commissioned by most of students present to organise a similar event next year. They say 'in the Midlands', and preferably 'late September'. They seemed willing to pay up to about £15. Will all those likely to be interested in attending please indicate same below, on back of application form for M500? Please state for which course(s) - this could be open to all, not just Halves.

LEAVE ALL BELOW BLANK, IF NOT INTERESTED, PLEASE

EDITORIAL   November 1974

Most subscriptions will expire with the January 1975 issue (M500/19 but it would help a lot if yon could let me have then NOW! It's no joke coping with even 300 subscriptions and two half-courses in February, and there may well be more than 300 next year.

Of course we have roaring inflation - postage and paper have increased and will continue to rise, besides which M500 doubled in size during the year – or didn't you notice? My 1974 estimates were based oh an anticipated average of 5 sheets of paper +10 stencils per issue, but now we regularly use 9-10 sheets and 18-20 stencils. + £1 for ink. There was never any hope of employing my eager team of ladies once the costs of materials virtually doubled, though they are still asking for jobs. I managed to spin out the £1 sub. by doing everything myself, and so should end the year with a marginal credit balance.

In short, folks, I could do with £1.50 or £2 sub for your next 10 issues (20-29, or from wherever you joined), but I've settled on £1.75 as looking fairly reasonable, and hope most of you will agree. As before, if anyone genuinely cannot raise the funds, please let me know. This publication is not avaricious, and there is no charge at all for bona fide handicapped or OAPs. With £1.75 I should be able to employ my ladies to staple copies together and put them in envelopes etc. This job takes me 5 hours for 300 copies - stapling at 1300 sheets per hour, insertion at 150 copies per hour, and labels on envelopes 45 minutes for 300. I might even be able to employ someone to do the duplicating - around 5 or 6 hours.

Next point is that so far we have £10 towards the duplicator which was purchased last Spring costing £97. It is a Roneo 250 and was strongly recommended by unbiased experts as the ideal machine for clubs and societies. I agree. It folds up and tucks away like a sewing machine, and always produces good quality work unless I forget that it drinks ink like I drink coffee. A duplicator is essential equipment to be handed on to any future editor, as those of you who run Study Centre or other newsletters know all too well. Almost anyone can find someone with a typewriter, but access to 5-6 hrs. of duplicator time is far from easy to obtain. So, we still need £87 to make this duplicator the property of M500 instead of mine, and thus ensure that M500's survival is independent of yours truly. I am hoping that you will feel like sending £2 subs instead of £1.75, and then the odd 25p each can go into the duplicator fund - though it still would not be enough, if you work it out. Please, as they say in the charity appeals, BE GENEROUS? If (joke) I get too much, I will report back - but of course in such unlikely circs, we could always go for a decent typewriter complete with math, symbols!

On the Renewal Form below you will see that I ask for your votes on whether or not to change the title of M500 to 'Open Set'.

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RENEWAL OF SUBSCRIPTION   (delete where applicable)