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ABSTRACT

Seeking to evaluate the effectiveness of the Preparatory Division, which offers remedial courses at the University of Louisville, this study focused on the academic outcomes of remedial instruction in mathematics and on participating students' subsequent ability to undertake and succeed in college-level mathematics courses. The study included 810 students enrolled in one of two remedial courses during the Fall of 1985 and the performance of this population through the end of Fall 1986. The findings indicated that: students most deficient in mathematics skills were least likely to complete their remedial mathematics curriculum; students in the more advanced of the two remedial courses had an attrition rate approaching the overall University population's attrition rate; by Fall 1986 nearly 20 percent of the original pool had gone on to successfully complete the first college-level mathematics course. In addition, females were more likely to take remedial mathematics than males but were also more likely to perform satisfactorily and to persist. An appendix examines the projected impact of a general education requirement in mathematics. (JB)

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I. Introduction

The Preparatory Division has the mission of providing remedial/developmental instruction for University of Louisville students. Based on the results of required placement tests, students assigned to the Division may be placed in or exempted from courses in the basic skills of reading, writing and mathematics. Students enrolled in the degree-granting units may also be required, based on ACT sub-test and/or placement test scores, to register for remedial coursework in writing and mathematics.

The remedial instructional programs of the Preparatory Division are designed to prepare students to undertake and succeed in college-level coursework. The academic performance of students enrolled in remedial courses, and the subsequent performance of the same students in college-level courses for which they have been prepared, are the most significant objective measures of the effectiveness of these programs.

This study will focus on the academic outcomes of remedial instruction in mathematics and will serve as a companionpiece to the recently completed study of the remedial English program. A separate study of the remedial reading program will be undertaken in the near future.

II. Design of the Study

The purpose of this research project is to determine how students perform in MATH 075 ("Basic Mathematics") and MATH 099 ("Elementary Algebra"), and to determine how students, who negotiate the remedial mathematics curriculum successfully, perform in MATH 102 ("Intermediate Algebra"), MATH 107 ("Finite Mathematics") and higher level mathematics courses. The population under scrutiny includes all students who enrolled in either MATH 075 or MATH 099 as their first mathematics course at the University during the Fall 1985 semester. The performance of this population was followed through the end of Fall 1986.

A "Counseling Report" for each student in this population was obtained from the Office of the Registrar and served as the source of academic and some demographic data. Grade distributions, ACT Standard Research Service Reports, and Division records provided additional information. These variables were subjected to simple computer analysis to generate the results that follow. While non-academic factors such as student motivation and effort are crucial to performance, such factors are not readily quantifiable and were excluded from consideration in this study.

Unlike the English sequence, in which remedial courses led to a University-wide requirement (i.e., ENG 101-102), no University-wide mathematics requirement existed during the period under study. Thus, while it could be assumed that an academically successful student in English would progress from remedial through college-level English, no such pattern of progress could be assumed with respect to mathematics.

Some students (e.g., in the Preparatory Division) could be required to take only one remedial mathematics course and, if their intended major required no mathematics, passing that one course, without any further progress, could be considered "academic success." Others could be required to complete a series of courses beginning with a remedial mathematics course and ending with MATH 108 (for the School of Business), MATH 152 (for some Education majors), or MATH 190. Consequently, the policy framework within which the mathematics curriculum existed imposes certain inescapable limitations on how the performance and progress of students placed initially in remedial mathematics might be interpreted. These limitations should be borne in mind before attempting to generalize too broadly from the data presented herein.

III. The Performance and Progress of Students Placed in MATH 075

A total of 389 students enrolled in MATH 075, as their first mathematics course, in the Fall 1985 semester. Of this group (note Table I), 282 (72.5%) were Preparatory Division students, 81 (20.8%) were enrolled in the College of Arts and Sciences, and the remaining 26 (6.7%) were enrolled in other academic or enrollment units. The population, across units, was predominantly female (58.9%).

Table I.

MATH 075 SUB-GROUPS: SELECTED ACADEMIC CHARACTERISTICS

UNIT	N	%	ACTM	ACTCOMP	CGPA	CHOURS
AH	1	.3%	11.00	21.00	2.87	43.00
AS	81	20.8%	10.18	16.77	2.03	36.86
BUS	2	.5%	15.00	18.00	2.69	122.50
CS	19	4.9%	1.00	7.00	2.50	14.31
ED	1	.3%	0.00	0.00	3.79	102.00
NUR	1	.3%	9.00	15.00	3.84	44.00
PD	282	72.5%	6.64	10.48	1.62	17.60
SS	2	.5%	13.00	17.50	1.41	13.50
GROUP	389		7.37	11.77	1.76	22.40
FEMALE	229	58.9%				
MALE	157	40.4%				
NO RECORD	3	.8%				
GROUP	389					

The mean ACT mathematics sub-test score of Division students was 6.64; the mean ACT composite score of this group was 10.48, both lower than the 11.6 mean ACT composite score for all Division students in 1985-86 (according to the ACT Standard Research Service Report). Arts

and Sciences students reported mean ACT mathematics and composite scores of 10.18 and 16.77, respectively, also lower than the 19.7 mean composite score noted for 1985-86 freshmen.

Interestingly, the mean ACT mathematics score for the entire MATH 075 population (7.37) was significantly lower than the mean ACT English score (8.97) for the 1985-86 ENG 098 population---although placement in ENG 098 (70 students) was far less common than placement in MATH 075 (389 students). This reflects the persistence of a pattern identified in other research that, irrespective of the general level of academic achievement attained by students (as measured by the ACT), students tend to be weakes. in the area of basic mathematics skills.

The cumulative academic performance and progress of MATH 075 students are represented in Table II:

Table II.

PERFORMANCE AND PROGRESS OF MATH 075 STUDENTS
(Percentage of Total Population: N=389)

	PASSED	%	ENROLLED SPRING '87	%
MATH 075	291	74.8%	7	1.8%
MATH 099	111	28.5%	37	9.5%
MATH 102	31	8.0%	27	6.9%
MATH 107	3	0.8%	6	1.5%
MATH 108	0	0.0%	4	1.0%
MATH 109	0	0.0%	1	0.3%
MATH 151	1	0.3%	0	0.0%
MATH 190	1	0.3%	2	0.5%

These data indicate that roughly 75% of all students placed in MATH 075 in Fall 1985 had passed the course by the end of Fall 1986.

This cumulative pass rate was considerably lower than those reported for students began ENG 098 (85.7%) or ENG 099 (83.2%) in Fall 1985. Table III reflects the detailed pattern of performance by term for this population:

Table III.

MATH 075 DATA ANALYSIS: FALL 1985 - SPRING 1987

	FALL 1985		TERM II		TERM III		TERM IV		TOTAL	
	N	%	N	%	N	%	N	%	N	%
MATH 075										
A	84	21.6%	4	6.1%	0	0.0%			88	18.8%
B	83	21.3%	8	12.1%	3	21.4%			94	20.0%
C	90	23.1%	14	21.2%	5	35.7%			109	23.2%
F	110	28.3%	31	47.0%	3	21.4%			144	30.7%
AU	1	.3%	1	1.5%	0	0.0%			2	.4%
I	0	0.0%	0	0.0%	0	0.0%			0	0.0%
P	0	0.0%	0	0.0%	0	0.0%			0	0.0%
W	21	5.4%	8	12.1%	3	21.4%			32	6.8%
TOTAL	389		66		14		0		469	
MATH 099										
A			25	11.8%	2	3.3%	0	0.0%	27	9.8%
B			29	13.7%	5	8.3%	0	0.0%	34	12.3%
C			37	17.5%	13	21.7%	0	0.0%	50	18.1%
F			80	37.7%	29	48.3%	3	75.0%	112	40.6%
AU			2	.9%	2	3.3%	1	25.0%	5	1.8%
I			0	0.0%	0	0.0%	0	0.0%	0	0.0%
P			0	0.0%	0	0.0%	0	0.0%	0	0.0%
W			39	18.4%	9	15.0%	0	0.0%	48	17.4%
TOTAL	0		212		60		4		276	

	FALL 1985		TERM II		TERM III		TERM IV		TOTAL	
	N	%	N	%	N	%	N	%	N	%
MATH 102										
A					7	15.9%	0	0.0%	7	15.2%
B					5	11.4%	0	0.0%	5	10.9%
C					9	20.5%	0	0.0%	9	19.6%
D					10	22.7%	0	0.0%	10	21.7%
F					8	18.2%	2	100.0%	10	21.7%
AU					1	2.3%	0	0.0%	1	2.2%
I					0	0.0%	0	0.0%	0	0.0%
P					0	0.0%	0	0.0%	0	0.0%
W					4	9.1%	0	0.0%	4	8.7%
TOTAL	0		0		44		2		46	
MATH 107										
A					0	0.0%	0	0.0%	0	0.0%
B					0	0.0%	0	0.0%	0	0.0%
C					1	20.0%	1	25.0%	2	22.2%
D					0	0.0%	1	25.0%	1	11.1%
F					2	40.0%	2	50.0%	4	44.4%
AU					0	0.0%	0	0.0%	0	0.0%
I					0	0.0%	0	0.0%	0	0.0%
P					0	0.0%	0	0.0%	0	0.0%
W					2	40.0%	0	0.0%	2	22.2%
TOTAL	0		0		5		4		9	
MATH 108										
A							0	0.0%	0	0.0%
B							0	0.0%	0	0.0%
C							0	0.0%	0	0.0%
D							0	0.0%	0	0.0%
F							0	0.0%	0	0.0%
AU							1	100.0%	1	100.0%
I							0	0.0%	0	0.0%
P							0	0.0%	0	0.0%
W							0	0.0%	0	0.0%
TOTAL	0		0		0		1		1	

	FALL 1985		TERM II		TERM III		TERM IV		TOTAL	
	N	%	N	%	N	%	N	%	N	%
MATH 151										
A					0	0.0%			0	0.0%
B					1	50.0%			1	50.0%
C					0	0.0%			0	0.0%
D					0	0.0%			0	0.0%
F					1	50.0%			1	50.0%
AU					0	0.0%			0	0.0%
I					0	0.0%			0	0.0%
P					0	0.0%			0	0.0%
W					0	0.0%			0	0.0%
TOTAL	0		0		2		0		2	
MATH 190										
A							0	0.0%	0	0.0%
B							1	50.0%	1	50.0%
C							0	0.0%	0	0.0%
D							0	0.0%	0	0.0%
F							0	0.0%	0	0.0%
AU							0	0.0%	0	0.0%
I							0	0.0%	0	0.0%
P							0	0.0%	0	0.0%
W							1	50.0%	1	50.0%
TOTAL	0		0		0		2		2	
GRAND TOTAL	389		278		125		13		805	
NO LONGER ENROLLED IN MATH			108	27.8%	241	62.0%	318	81.7%		

ENROLLED SPRING 1987

MATH 075	7
MATH 099	37
MATH 102	27
MATH 107	6
MATH 108	4
MATH 109	1
MATH 190	2
TOTAL	84

While it could be assumed, with confidence, that students who passed ENG 098 would (or should) next attempt ENG 099, and that those who passed ENG 099 would (or should) next attempt ENG 101, students who passed MATH 075 had the legitimate option, depending on their unit or program requirements, of choosing not to register for MATH 099. In this context, a significant minority of the MATH 075 population (127 students, or 32.6% of the original group) chose to discontinue enrollment in mathematics at some point---not due to any failure on the part of the students or of the mathematics program. Table IV illustrates this phenomenon:

Table IV.

MATH 075: PROGRESS THROUGH THE MATHEMATICS CURRICULUM
(Column percentages)

	MATH 075		MATH 099		MATH 102		MATH 102+	
	N	%	N	%	N	%	N	%
ATTEMPTED	389		212		71		23	
PASSED	291	74.8%	111	52.4%	31	43.7%	5	21.7%
DID NOT PASS	91	23.4%	64	30.2%	13	18.3%	5	21.7%
ENROLLED S'87	7	1.8%	37	17.5%	27	38.0%	13	56.5%
PASSED, DID NOT CONTINUE (% of N)	79	20.3%	40	18.9%	8	11.3%		
% OF STUDENTS PASSING WHO DID NOT CONTINUE		27.1%		36.0%		25.8%		

Female students were more likely to remain enrolled than were male students placed in MATH 075. Moreover, only 40% of the Preparatory Division students in this population (113 of 282 students) were still enrolled in the University for Spring 1987 (see Table V). Of those still enrolled, 56.6% (64 of 113 students) had transferred to the College of Arts and Sciences. Several others had satisfied their mathematics requirement for transfer, but had failed to satisfy one of the other transfer requirements.

Table V.

MATH 075 POPULATION: ATTRITION AND RETENTION
(Row Percentages)

UNIT	ENROLLED IN UofL SPRING '87	%	NOT ENR. IN UofL SPRING '87	%	TOTAL
Allied Health	1	100.0%	0	0.0%	1
A & S	46	56.8%	35	43.2%	81
Business	1	50.0%	1	50.0%	2
Continuing Std.	3	15.8%	16	84.2%	19
Education	1	100.0%	0	0.0%	1
Nursing	1	100.0%	0	0.0%	1
PREP	113	40.1%	169	59.9%	282
NON-TRANSFERS	49	26.1%	139	73.9%	188
TRANSFERS	64	68.1%	30	31.9%	94
Speed	1	50.0%	1	50.0%	2
TOTAL	167	42.9%	222	57.1%	389
Female	104	45.4%	125	54.6%	229
Male	60	38.2%	97	61.8%	157
No Record	3	100.0%	0	0.0%	3
TOTAL	167	42.9%	222	57.1%	

Several conclusions may be drawn from these data. While three of four students placed in MATH 075 eventually passed the course, the percentage of these students choosing to attempt higher level courses in the mathematics sequence decreased progressively. Because of the comparatively high failure and non-completion rate in MATH 075, a number of students repeated the course one or more times. Only half of the students who needed to re-enroll in MATH 075 ever passed the course. Thus, the presence of these students in the total MATH 075 population contributed to a slightly lower pass rate (ca. 64%) for all students enrolled in MATH 075 than that reported herein for first-time MATH 075 students.

On the other hand, the students who passed MATH 075 and proceeded to enroll in MATH 099 had a pass rate, on their first attempt, of 43.0%, compared with a semester pass rate of 54-56% for all students enrolled in MATH 099. Thus, while 52.4% of the former MATH 075 students who attempted MATH 099 eventually passed the course, their presence in a given semester tended to lower the overall pass rate.

Students placed in MATH 075 were less likely to remain enrolled (42.9% retained through Spring 1987) in the University than were students placed initially in ENG 098 or ENG 099 (48.6% and 49.3%, respectively). Male students, in particular, were less likely to be retained.

IV. Performance and Progress of Students Placed in MATH 099

A total of 421 students enrolled in MATH 099, as their first mathematics course, in the Fall 1985 semester. Of this group, 217 (51.5%) were enrolled in Arts and Sciences, 162 (38.5%) were enrolled in the Preparatory Division, and the remaining 42 (10.0%) were enrolled in other units (note Table VI).

Table VI

MATH 099 SUB-GROUPS: SELECTED ACADEMIC CHARACTERISTICS

UNIT	N	%	ACTM	ACTCOMP	CGPA	CHOURS
AH	2	.5%	5.00	11.00	2.98	54.00
AS	217	51.5%	13.09	16.90	1.84	31.76
BUS	8	1.9%	16.67	20.00	3.06	98.75
CS	16	3.8%	12.25	17.50	2.45	10.53
ED	6	1.4%	14.67	17.67	2.64	92.17
NUR	9	2.1%	11.29	17.00	2.98	60.89
PD	162	38.5%	9.01	11.76	1.69	23.13
SS	1	.2%	0.00	0.00	2.97	86.00
GROUP	421		11.22	14.61	1.88	30.69
FEMALE	226	53.7%				
MALE	195	46.3%				
GROUP	421					

Both the mean ACT mathematics and composite scores were higher for the various sub-groups in this population than for students enrolled in MATH 075. In addition, the presence of a small number of students who had transferred from other institutions into the School of Business or the School of Education, and who had to complete

mathematics courses required by these units, inflated the mean cumulative hours earned figures.

The cumulative performance and progress of MATH 099 students are represented in Table VII:

Table VII

CUMULATIVE PERFORMANCE OF MATH 099 STUDENTS

	PASSED	%	SPRING 1987	%
MATH 075	4	1.0%	0	0.0%
MATH 099	288	68.4%	15	3.6%
MATH 102	127	30.2%	28	6.7%
MATH 107	38	9.0%	16	3.8%
MATH 108	23	5.5%	15	3.6%
MATH 109	5	1.2%	1	.2%
MATH 151	5	1.2%	0	0.0%
MATH 190	5	1.2%	3	.7%
MATH 205	0	0.0%	1	.2%

Of the 421 students enrolled in MATH 099, 253 (60.1%) passed the course in their first semester, and 288 (68.4%) had passed by the end of Fall 1986. As with the MATH 075 population, this cumulative pass rate was considerably lower than that noted for students enrolled in ENG 098 or ENG 099. Table VIII reflects the detailed pattern of performance by term for this population:

Table VIII.

MATH 099 DATA ANALYSIS: FALL 1985 - SPRING 1987

FALL 1985	TERM II		TERM III		TERM IV		TOTAL	
	N	%	N	%	N	%	N	%
MATH 075								
A	1	33.3%	0	0.0%			1	25.0%
B	0	0.0%	1	100.0%			1	25.0%
C	2	66.7%	0	0.0%			2	50.0%
F	0	0.0%	0	0.0%			0	0.0%
AU	0	0.0%	0	0.0%			0	0.0%
I	0	0.0%	0	0.0%			0	0.0%
P	0	0.0%	0	0.0%			0	0.0%
W	0	0.0%	0	0.0%			0	0.0%
TOTAL	0		3		1		0	4
MATH 099								
A	93	22.1%	1	1.6%	0	0.0%	0	0.0%	94	19.1%
B	80	19.0%	11	17.2%	2	40.0%	0	0.0%	93	18.9%
C	80	19.0%	18	28.1%	2	40.0%	1	100.0%	101	20.6%
F	128	30.4%	30	46.9%	0	0.0%	0	0.0%	158	32.2%
AU	1	.2%	0	0.0%	1	20.0%	0	0.0%	2	.4%
I	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
P	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
W	39	9.3%	4	6.2%	0	0.0%	0	0.0%	43	8.8%
TOTAL	421		64		5		1	491

	FALL 1985		TERM II		TERM III		TERM IV		TOTAL	
	N	%	N	%	N	%	N	%	N	%
MATH 102										
A			31	19.5%	1	3.6%	0	0.0%	32	16.9%
B			28	17.6%	2	7.1%	0	0.0%	30	15.9%
C			31	19.5%	3	10.7%	0	0.0%	34	18.0%
D			18	11.3%	13	46.4%	0	0.0%	31	16.4%
F			40	25.2%	7	25.0%	2	100.0%	49	25.9%
AU			2	1.3%	0	0.0%	0	0.0%	2	1.1%
I			1	.6%	0	0.0%	0	0.0%	1	.5%
P			1	.6%	0	0.0%	0	0.0%	1	.5%
W			7	4.4%	2	7.1%	0	0.0%	9	4.8%
TOTAL	0		159		28		2		189	
MATH 107										
A			4	13.3%	2	6.7%	1	14.3%	7	10.4%
B			3	10.0%	7	23.3%	1	14.3%	11	16.4%
C			4	13.3%	9	30.0%	1	14.3%	14	20.9%
D			5	16.7%	1	3.3%	0	0.0%	6	9.0%
F			13	43.3%	6	20.0%	4	57.1%	23	34.3%
AU			0	0.0%	0	0.0%	0	0.0%	0	0.0%
I			0	0.0%	0	0.0%	0	0.0%	0	0.0%
P			0	0.0%	0	0.0%	0	0.0%	0	0.0%
W			1	3.3%	5	16.7%	0	0.0%	6	9.0%
TOTAL	0		30		30		7		67	
MATH 108										
A			0	0.0%	3	12.0%	0	0.0%	3	8.8%
B			1	33.3%	3	12.0%	2	33.3%	6	17.6%
C			2	66.7%	5	20.0%	1	16.7%	8	23.5%
D			0	0.0%	5	20.0%	1	16.7%	6	17.6%
F			0	0.0%	4	16.0%	0	0.0%	4	11.8%
AU			0	0.0%	0	0.0%	0	0.0%	0	0.0%
I			0	0.0%	1	4.0%	0	0.0%	1	2.9%
P			0	0.0%	0	0.0%	0	0.0%	0	0.0%
W			0	0.0%	4	16.0%	2	33.3%	6	17.6%
TOTAL	0		3		25		6		34	

	FALL 1985		TERM II		TERM III		TERM IV		TOTAL	
	N	%	N	%	N	%	N	%	N	%
MATH 109										
A			1	33.3%	0	0.0%			1	16.7%
B			0	0.0%	1	33.3%			1	16.7%
C			1	33.3%	2	66.7%			3	50.0%
D			0	0.0%	0	0.0%			0	0.0%
F			1	33.3%	0	0.0%			1	16.7%
AU			0	0.0%	0	0.0%			0	0.0%
I			0	0.0%	0	0.0%			0	0.0%
P			0	0.0%	0	0.0%			0	0.0%
W			0	0.0%	0	0.0%			0	0.0%
TOTAL	0		3		3		0		6	
MATH 151										
A			0	0.0%	1	16.7%			1	11.1%
B			1	33.3%	1	16.7%			2	22.2%
C			0	0.0%	2	33.3%			2	22.2%
D			0	0.0%	0	0.0%			0	0.0%
F			1	33.3%	0	0.0%			1	11.1%
AU			0	0.0%	0	0.0%			0	0.0%
I			0	0.0%	2	33.3%			2	22.2%
P			0	0.0%	0	0.0%			0	0.0%
W			1	33.3%	0	0.0%			1	11.1%
TOTAL	0		3		6		0		9	
MATH 152										
A							0	0.0%	0	0.0%
B							0	0.0%	0	0.0%
C							0	0.0%	0	0.0%
D							0	0.0%	0	0.0%
F							0	0.0%	0	0.0%
AU							0	0.0%	0	0.0%
I							0	0.0%	0	0.0%
P							0	0.0%	0	0.0%
W							2	100.0%	2	100.0%
TOTAL	0		0		0		2		2	

	FALL 1985		TERM II		TERM III		TERM IV		TOTAL	
	N	%	N	%	N	%	N	%	N	%
MATH 190										
A					1	8.3%	0	0.0%	1	7.7%
B					1	8.3%	0	0.0%	1	7.7%
C					1	8.3%	0	0.0%	1	7.7%
D					2	16.7%	0	0.0%	2	15.4%
F					2	16.7%	0	0.0%	2	15.4%
AU					0	0.0%	0	0.0%	0	0.0%
I					0	0.0%	0	0.0%	0	0.0%
P					0	0.0%	0	0.0%	0	0.0%
W					5	41.7%	1	100.0%	6	46.2%
TOTAL	0		0		12		1		13	
MATH 205										
A					0	0.0%	0	0.0%	0	0.0%
B					0	0.0%	0	0.0%	0	0.0%
C					0	0.0%	0	0.0%	0	0.0%
D					0	0.0%	0	0.0%	0	0.0%
F					0	0.0%	1	50.0%	1	33.3%
AU					0	0.0%	0	0.0%	0	0.0%
I					0	0.0%	0	0.0%	0	0.0%
P					0	0.0%	0	0.0%	0	0.0%
W					1	100.0%	1	50.0%	2	66.7%
TOTAL	0		0		1		2		3	
GRAND TOTAL	421		265		111		21		818	
NO LONGER ENROLLED IN MATH			146	34.7%	249	59.1%	326	77.4%		

ENROLLED SPRING 1987	
MATH 075	7
MATH 099	15
MATH 102	28
MATH 107	16
MATH 108	15
MATH 109	1
MATH 190	3
MATH 205	1
TOTAL	86

As with the MATH 075 population, a number of students voluntarily discontinued their enrollment in mathematics after passing MATH 099. However, since (in Fall 1985) MATH 099 was a prerequisite for MATH 102, MATH 107, and MATH 151, students did not always move from one level to another in an "orderly" fashion. In addition, a few students enrolled in mathematics courses offered through Speed School; these students (and the courses in which they enrolled) were not tracked. Table IX attempts to capture this rather complex pattern:

TABLE IX

MATH 099: PROGRESS THROUGH THE MATHEMATICS CURRICULUM
(Column percentages)

	MATH 099		MATH 102*		MATH 107+		MATH 107+	
	N	%	N	%	N	%	N	%
ATTEMPTED	421		206		77		23	
PASSED	288	68.4%	158	76.7%	37	48.1%	3	13.0%
DID NOT PASS	118	28.0%	20	9.7%	20	26.0%	4	17.4%
ENROLLED S'87	15	3.6%	28	13.6%	20	26.0%	16	69.6%
PASSED, DID NOT CONTINUE (% of N)	82	19.5%	81	39.3%	14	18.2%		
% OF STUDENTS PASSING WHO DID NOT CONTINUE		28.5%		51.3%		37.8%		

* 38 Students moved from MATH 099 to MATH 107 or above.

Preparatory Division students, who enrolled initially in MATH 099, were retained at a higher percentage rate (56.2%) than were Division students placed initially in MATH 075 (40.0%). Although MATH 099 was not a Division transfer requirement, the Division students who attempted and passed the course, before or after transferring to Arts and Sciences, were more likely to be enrolled for Spring 1987 than were students who remained in the Division---and A&S students. Moreover, as was the case with MATH 075 students, female MATH 099 students were more likely to be retained than were male students (see Table X).

Table X.

MATH 099 POPULATION: ATTRITION AND RETENTION
(Row percentages)

UNIT	ENROLLED IN UofL SPRING '87	%	NOT ENR. IN UofL SPRING '87	%	TOTAL
ALLIED HEALTH	2	100.0%	0	0.0%	2
A & S	90	41.5%	127	58.5%	217
BUSINESS	7	87.5%	1	12.5%	8
CONT. STUD.	0	0.0%	16	100.0%	16
EDUCATION	5	83.3%	1	16.7%	6
NURSING	9	100.0%	0	0.0%	9
PREP	91	56.2%	71	43.8%	162
NON-TRANSFERS	29	31.5%	63	68.5%	92
TRANSFERS	62	88.6%	8	11.4%	70
SPEED	1	100.0%	0	0.0%	1
TOTAL	205	48.7%	216	51.3%	421
FEMALE	116	51.3%	110	48.7%	226
MALE	89	45.6%	106	54.4%	195
TOTAL	205	48.7%	216	51.3%	421

While 68.4% of the students who first enrolled in MATH 099 in Fall 1985 eventually passed the course, the percentage of these students choosing to continue enrollment in mathematics decreased progressively. Students who began in MATH 099 fared considerably

better in the course than did students who moved to MATH 099 from MATH 075. However, only 20.7% of the students who failed to complete MATH 099 on their initial attempt were ever successful in repeating the course---a percentage much lower than that for students repeating MATH 075 (i.e., 50.0%).

Only 48.9% (206/421) of the students in the MATH 099 population ever attempted a higher level mathematics course. However, 79.8% of the students who passed MATH 099, and then proceeded to enroll in a college-level mathematics course, were successful.

Students placed in MATH 099 were retained at a rate (48.7%) greater than that of students placed in MATH 075 (42.9%). Ironically, the much higher retention rate of Preparatory Division students compensated for the lower retention rates of MATH 099 students from other units.

IV. Conclusion

In the Fall 1985 semester, the remedial mathematics program served a total of 810 students enrolled in either MATH 075 or MATH 099 as their first mathematics course. The bulk of this aggregate population had been admitted either to the Preparatory Division (54.8%) or to the College of Arts and Sciences (36.8%)---with the Division having the majority of students placed in MATH 075 (72.5%) and A&S having a majority of the students placed in MATH 099 (51.5%).

By the end of Fall 1986, i.e., after a maximum of periods of possible enrollment, 49.3% (399) of these students had passed MATH 099, 19.5% (158) had passed MATH 102, and another 10.0% had passed at least one course beyond MATH 102. In addition, 12.8% (104) were enrolled in MATH 102 or above for Spring 1987.

The students most deficient in mathematics skills, as evidenced by their placement in MATH 075, were least likely (28.5%) to complete the remedial mathematics curriculum. However, since many of these students were assigned to the Preparatory Division, and only MATH 075 was a Division transfer requirement, a considerable number of students did not attempt MATH 099 after passing MATH 075. Had these students attempted MATH 099, and performed as well as the students who did enroll in the course, the percentage completion rate would have approached 40-45%.

Students placed in MATH 075, regardless of their enrollment unit, had a higher probability of eventual attrition than that reported for students placed in MATH 099. It is important to note, however, that the attrition rate of MATH 099 students (51.3%) approximated that of the general University population through the end of the sophomore year (i.e., 45-50%), and the 57.1% attrition rate of MATH 075 students, while higher, was not excessively so.

Female students were more likely to be placed in remedial mathematics than were males, but were also more likely to perform satisfactorily and to persist. This represents a pattern different from that identified in the recent ENG 098/099 study, i.e., male students were more likely to be placed in remedial English (57.8%), but female students were more likely to perform acceptably and to persist (51.3% for females compared to 47.0% for males).

In summary, the data examined in this study indicate that the remedial mathematics program provided effective instruction to students placed in MATH 075 and MATH 099. For the students who chose to continue their enrollment in mathematics courses, the remedial instruction they had received was effective preparation for college-level mathematics.

APPENDIX

The Projected Impact of a General Education Requirement in Mathematics

To comply with the accreditation guidelines of the Southern Association of Colleges and Schools (SACS), general education requirements in mathematics have been adopted by the University's various undergraduate units. The proposed implementation of such a requirement (effective Fall 1988) in the College of Arts and Sciences, depending on the difficulty level of the course chosen or developed for this purpose, could have a tremendous impact on the academic careers of a great many students. Using the data generated by this study, it is possible, and may be valuable, to project this impact.

The current ACT placement criteria for mathematics are as follows:

Course	ACT Mathematics Score Range
MATH 075	1 - 15
MATH 099	16 - 19
MATH 102	20 - 23
MATH 108, 190	24 - 27
MATH 205	28 or Above

A college-level mathematics requirement at, for example, the MATH 102 level, would have a minimum ACT Mathematics sub-test score of 20. Students with lower mathematics scores would be required either to "test into" MATH 102 or to take MATH 075 and/or MATH 099 before attempting MATH 102.

In recent years, students admitted to the University have presented the following ACT scores:

	ACT Mathematics		ACT Composite	
	Mean	S.D.	Mean	S.D.
1983-84	16.20	7.90	18.00	5.90
1984-85	16.97	7.53	18.46	5.54
1985-86	16.97	7.46	18.72	5.48
1986-87	17.50		19.20	

Approximately 60% of all students admitted to the University have had ACT mathematics scores below 20 (according to the ACT Standard Research Service Reports). Thus, assuming 2,500 first-time students each year, approximately 1,500 students could be required to begin mathematics instruction in a remedial course. Furthermore, if MATH 102 is redefined as a remedial course, as many as 80% (i.e., 2,000) of all entering students would need to complete MATH 075, and/or MATH 099, and/or MATH 102 (however it was designated) before attempting the required course.

Under the policies existing in Fall 1985, this study indicates that roughly 20% of the MATH 075/099 population had completed MATH 102 by the end of Fall 1986, and another 12.8% were registered in MATH 102 for Spring 1987. Assuming that students, who passed MATH 075 and/or MATH 099 without proceeding to MATH 102, would persist through MATH 102 at the same pass rate reported herein---the MATH 102 completion rate could reach ca. 40-45%.

For students beginning in MATH 075 (as many as 720 of the projected 1,500 students), only 20-25% (i.e, 144 to 180) would be likely to pass MATH 102; smaller classes and more intensive instructional support could raise this percentage to ca. 35% (i.e., 252 students). For students beginning in MATH 099 (as many as 780 of the projected 1,500 students), as many as 55-60% would be likely to pass MATH 102 (i.e., 429 to 468). At most, 40% (720 students) of this segment of the entering population would be likely to satisfy such a requirement. The number of the entering students who would be able to move directly into MATH 102, and who would not complete the course successfully, cannot be determined reliably. These completion percentages would be lower should a course more difficult than MATH 102 be used as the mathematics general education requirement.

The new high school curriculum requirements may raise the level of mathematics skills possessed by future high school graduates. The new minimum admissions standards may limit the numbers of weaker mathematics students admitted to the University. These possibilities

notwithstanding, the implementation of a mathematics general education requirement at the MATH 102 level, or above, would commit the University to a massive instructional program at both the remedial and college levels. Moreover, such a requirement could become a major cause of the attrition of University undergraduate students.

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