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ACTUARIAL STUDENTS, EXAMINATIONS, AND THE PROFESSION

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INTRODUCTION

For a number of years the actuarial profession has been faced with problems posed by a shortage of qualified actuaries. Various suggestions have been made intended to help alleviate this shortage. Several have been aimed at: (1) acquainting more people with the actuarial profession; (2) encouraging capable students to attempt the examinations; (3) speeding the progress of students through the examinations (without taking the obvious but unsatisfactory step of lowering standards); and (4) dissuading capable students from dropping out of the examination program. Some of the suggestions have been adopted; for example, establishment of cash prizes for the leading undergraduates in the General Mathematics Examination, establishment of regional high-school mathematics contests, changes in the examination syllabus, institutional advertising by a few large insurance companies, and the establishment of actuarial scholarships at a few universities prominent in actuarial education.

Perhaps these attempts have met with some degree of success, but there has been little verification or measurement. In fact, there have been surprisingly few statistical investigations of the various phases of the basic problem. The Canadian Association of Actuaries has, through questionnaires sent to younger Society members, obtained some valuable information limited entirely to Canadians and primarily to those who have had success in the examinations. Spoerl studied the correlation between success in the examinations and success on the job,[1] and the Education and Examination Committee has occasionally released figures showing the passing percentages on the various examinations.[2] As a part of the informal discussion at a few Society meetings evidence has been offered that the prize-winners of recent years have had a very poor record of progress in subsequent examinations.[3] It is apparent that conjecture and intuition have, to a considerable extent, served as guides in determining

[1] *TSA*, I, 42.

[2] *TSA*, VII, 290, 292.

[3] *TSA*, IX, 96; X, 673; XIII, 151.

policy related to the recruiting, education, and examination of actuarial students.

Purpose

It would appear desirable to try to get factual answers to some of these important questions. This would be consistent with the motto by John Ruskin which appears on the title page of each volume of the *Transactions* of the Society: "The work of science is to substitute facts for appearances and demonstrations for impressions." In line with this admonition, the primary purpose of the current study was to obtain statistical answers to the following questions:

1. How do prospective actuarial students first learn of the existence of the actuarial profession?
2. What induces them to attempt their first examination?
3. How big a part is played by the cash-prize offer?
4. What is their collegiate status at the time of passing the General Mathematics Examination and how much formal mathematics have they had at the time?
5. What subsequent examination progress have they made?
6. Why do capable students discontinue taking examinations?

Additional collateral information would be expected to follow as a by-product of such a study, and, indeed, a considerable amount was obtained. Some of this additional information is presented in the later sections of this paper.

Procedure

It appeared logical to obtain information on actuarial students directly from the source—the students themselves. Accordingly, during the spring of 1963, short questionnaires were mailed to a total of 925 actuarial students and new Fellows.[4] It was made perfectly clear in the covering letter that this study was entirely unofficial and independent of the Society as such. Returns were to be unsigned (although many bore signatures), and the promise was made that there would be no public identification of any individual replies.

The response to these questionnaires was remarkable. It was, of course, expected that new Fellows or students still successfully pursuing the examination series would be interested enough so that most would reply, but even those who had long since discontinued taking examinations replied in surprising numbers. A total of 754 replies were received, consti-

[4] The printing, mailing, coding, and card-punching were performed by the Bureau of Business Research, Graduate School of Business Administration, University of Michigan.

tuting 81.5 per cent of the total mailing. (Another dozen or so straggled in after the files were closed.) The 171 nonreturns included about 40 questionnaires which were nondeliverable because of lack of a valid current address.

The groups circularized were as follows:

Group A. The 213 nonprize-winning students who passed the General Mathematics Examination (hereinafter referred to as the "GME") in May, 1958. This group was chosen as being fairly recent, yet far enough back so that most members would have made a decision on continuance or discontinuance. Replies were received from 162—a 76.1 per cent return. There were returns from 5 of the 8 women.

Group B. The 375 nonprize-winners who passed the GME in May, 1962. This was the most recent such group available at the time. A total of 304 replies were received, representing a return rate of 85.2 per cent. Of the 23 women, 21 replied.

Group C. All the 145 students who won prizes from the inception of the cash-prize offer in 1947 through the examinations of May, 1962. Replies were received from 110—a return of 75.9 per cent. Only 2 of the 5 women prize-winners replied.

Group D. The 192 new Fellows of 1960, 1961, and 1962 who had not been included in any of the other three groups. A total of 178 replies were received, including one from the only woman, representing a 92.7 per cent return. Many of these were signed, and a considerable number contained interesting and thoughtful comments on the profession and the examinations.

The distribution of questionnaire replies is shown in the accompanying tabulation. The questionnaires sent to each of the groups—A, B, C, and

Nation	A 1958 GME	B 1962 GME	C Prize-winners	D New Fellows	Total
United States...	133	242	84	142	601
Canada.....	29	62	26	36	153
Total.....	162	304	110	178	754

D—contained several questions common to all as well as questions peculiar to the individual group.

The completed questionnaires were coded, the data were transferred to punched cards, and tables were prepared on an electronic computer. These tables showed both the number of cases in each subcategory and the corresponding percentages of row or column totals.

In analyzing the various tables which follow, the chronology should be borne in mind. Thus, differences between the A group of 1958 and the B group of 1962 probably reflect changes in the underlying factors over the four-year period. The C group of prize-winners covers a sixteen-year span during which changes occurred in several characteristics, so the group as a whole is not strictly homogeneous. Hence the totals in some instances are not properly comparable to the corresponding A or B group totals. Upon occasion, statistics will be presented which pertain to only a part of the C group, covering a more limited time span. The D group of new Fellows likewise covers a fairly long period of years, owing not only to the length of time required to become a Fellow but also to the considerable individual variance in this time, thus including persons whose starting dates had a fairly wide distribution.

RECRUITING OF STUDENTS INTO THE ACTUARIAL PROFESSION

Discovery of the Profession

It cannot be doubted that the general public is largely unaware of the existence of the actuarial profession. Even college students and graduates are often only dimly acquainted with the word "actuary." Awareness of the profession is an essential first step toward Fellowship. The Society, actuarial clubs, and some companies have tried by various means to publicize the profession. How successful have they been?

All four groups were asked to check off the source of their first information regarding the actuarial profession. They were asked to write in the proper answer if none of those suggested was appropriate. Fortunately, the written-in answers fell readily into three major categories.

In reviewing the replies to this question, it became apparent that conditions differed sufficiently between the United States and Canada to warrant separate analysis. The results are shown in Table 1. (In this and subsequent tables the percentages are rounded to the nearest integer, thus producing results which in some cases do not total 100 per cent.)

It is clear that the most important initial source of information in every subgroup but one is a relative or friend. This seems to be especially true in the case of the most successful students—the new Fellows. In both Canada and the United States the relative importance of this source appeared to decline from 1958 to 1962. However, in the United States the importance of the information from the college teacher or counselor also declined over the period, while in Canada it increased. The high-school teacher or counselor as a source of actuarial information appeared to be much more important in Canada in 1958 than in the United States, but by 1962 the percentages were almost identical. Just the opposite hap-

pened with regard to published material. It would seem that the institutional advertising by a few American companies has become a fairly important source of information.

It seems surprising that the high-school mathematics contests, which were not so well established in 1958 as in 1962, gained no ground in the United States over that period but had made a significant impact in Canada by 1962. Finally, the cash-prize offer played only an insignificant part in informing nonprize-winners of the existence of the profession, although it was important among the members of the prize-winning C group.

TABLE 1

INITIAL SOURCE OF INFORMATION REGARDING THE ACTUARIAL PROFESSION

SOURCE OF INFORMATION	UNITED STATES				CANADA			
	A 1958 GME	B 1962 GME	C Prize-winners	D New Fellows	A 1958 GME	B 1962 GME	C Prize-winners	D New Fellows
Relative, friend	33%	28%	33%	45%	45%	31%	19%	42%
High-school teacher	6	12	7	8	17	13	19	17
College teacher	29	18	21	29	21	31	35	22
High-school mathematical contest	5	5	5	1	0	13	4	0
Published material	12	18	13	7	14	8	4	14
Cash-prize offer	2	1	16	1	0	0	8	0
Permanent job	4	5	1	1	3	0	0	0
Summer job	1	3	1	1	0	1	8	6
Company recruiter	4	3	1	3	0	1	0	0
Miscellaneous	4	7	1	4	0	1	4	0

There were a number of comments regarding the lack of actuarial publicity which are typified by the following: "I feel that there has not been nearly enough information given at either the high-school or college level as to the type of work or opportunities available in the actuarial field."

The value of published material and the current scarcity of it was commented on by several. One of the new Fellows suggested that members of local actuarial clubs visit high schools and colleges in their area. Another offered the following interesting proposal:

There should be more publicity of the actuarial profession among engineers graduating from college. I was an engineer and learned of the actuarial field three years after graduation—would have started sooner. I believe there must be a significant number of engineering students who would be interested, and their math background is adequate. It would be important in approaching these people to emphasize that actuarial standards are high.

Regarding the type of publicity to be presented, some of the new Fellows felt that too much emphasis is placed upon the mathematical aspects of actuarial work. Two of such comments follow:

My only suggestion on public relations would be that the Society place a greater emphasis on the nonmath requirements and less emphasis on advanced mathematical subjects when discussing or presenting the work of the actuary to the college undergraduate. I think that most actuaries wish that they had spent more time in university on English, economics, finance, and related business subjects and less on advanced calculus, differential equations, theory of functions, etc.

Despite recent emphasis on other aspects of the profession in the public relations programs of insurance companies and actuarial organizations, most uninitiated college (and high-school) students really have little understanding of more than the purely mathematical aspects of actuarial work. Stress must be placed on the business aspects of company actuarial work. Perhaps co-ordinating actuarial public relations with that done by noninsurance business firms would help—i.e., concentrating on the explanation of what it takes to be outstanding in the general field of corporate management and the personal and material rewards involved.

In summary, there is evidence that more students are learning of the actuarial profession from high-school sources. However, in the United States, the mathematics contests do not seem to be having as much impact as had been hoped and expected. This may be due, in part, to the deliberate use of the "soft sell," at least in some regions. I know of contest winners who were totally unaware of the actuarial share of the sponsorship. Perhaps we should discard some of this modesty and make it more apparent that actuaries finance the contest and want students to learn of the profession. Perhaps the Society or local companies should send descriptive brochures to all contestants who make a reasonable score. Certainly, the informative efforts should not be confined to the few leading contestants. Many of these top students are destined to become pure mathematicians and are not real actuarial prospects.

The increase in the number learning of the profession through published material is very encouraging. Only a few companies have carried the ball thus far. Let us hope that more will follow this excellent example.

Original Reason for Taking the GME

All four groups were asked to check off the principal reason for taking the GME and to write in the reason if the given list did not suffice. Again, the write-ins fell readily into a few categories, so that coding was not a problem. Table 2 shows the results for the three groups—A, B, and D—where there was little difference between the replies of Americans and

Canadians. Two columns are devoted to the C group because there seemed to be significant differences by nation.

The similarity between the A and B percentages is striking, particularly if the first two items in each column are combined. The new Fellows seem to have been even more sure of their goal, and this certainly appears reasonable, even without making allowance for the anticipated persistency of those with a clear-cut goal.

On this question the prize-winners are significantly different from the other groups. In the United States a much lower proportion expressed actuarial interest, and the most important single reason given for trying the examination was to try to win a cash prize. The differences between

TABLE 2

PRINCIPAL REASON FOR TAKING THE GME

REASON	A 1958 GME	B 1962 GME	C PRIZE-WINNERS		D NEW FELLOWS
			United States	Canada	
Definite interest in becoming an actuary	43%	37%	21%	19%	57%
Reasonable possibility of becoming interested	41	46	26	50	33
To win a cash prize	2	2	29	12	1
Considered it a challenge	2	3	5	0	6
Requirement of job	12	11	18	19	3
Miscellaneous	1	0	1	0	0

the Canadian prize-winners and the members of the A and B groups was less pronounced but still significant.

Some eight or ten students commented on the fact that examinations are often taken almost solely to assist in getting a summer job. The following excerpts from the A and C groups are typical:

It appears to me that a high proportion of students who write the early parts (Old 1, 2, 3), especially those who do well, have, as I had, no intention of continuing in the profession. We write the exams and take the summer jobs primarily for the immediate gain.

At the time [1958] I was interested in pure mathematics and the only reason for taking the exams was to get the summer job (which I got but did not take). I was later approached by a number of insurance companies about the possibility of my becoming an actuary, but I got the impression that, the further along I got in the field, the less mathematics I would be doing. Therefore I decided against it.

To summarize, over four-fifths of the ordinary students passing the GME indicate either a definite or a possible interest in actuarial work. Better than 11 per cent take the examination because of encouragement or direction from their employer in either a summer or a permanent job. The attempt to induce students to take the examination by offering a prize has met with little success except among a few gifted mathematical students who, by and large, have no further interest in the profession, as is shown further on. The student must first become interested in the profession and its opportunities; the examinations will then follow in due course.

Effect of the Cash-Prize Offer

In order to pin down still further the reasons for taking the GME, the respondents were asked whether the existence of the cash-prize offer

TABLE 3

EFFECT OF CASH-PRIZE OFFER ON INDUCING STUDENTS TO TAKE THE GME

Part Played by Cash-Prize Offer	A 1958 GME	B 1962 GME	C Prize-winners	D New Fellows
Major part	1%	2%	20%	0%
Minor part	6	11	23	4
No part at all	93	87	49	94
No reply	0	1	8	2

played a major part, any part at all, or no part whatever in the decision to take the GME. In no group was there an appreciable difference by nation, so no subdivisions of groups are presented in Table 3.

Again, the obvious conclusion is that the existence of the cash prizes has little effect in inducing anyone to take the GME except the ultimate prize-winners themselves. It is shown later (Table 17) that there has been an increasing trend in more recent years among this latter group to state, as the major reason for taking the examination, the hope of winning a prize.

THE GENERAL MATHEMATICS EXAMINATION

Academic Status at the Time of Passing the GME

Each student in the A, B, and C groups was asked to check his academic status at the time of passing the GME. Because of the fact that the prizes are intended to be limited to undergraduates (although one winner was actually in high school at the time), the percentages shown for C in the

first section of Table 4 are not strictly comparable to those of A and B. Accordingly, another section was compiled, restricted to those persons who were undergraduates at the time. Both results are shown in Table 4.

The comparison between the 1958 and 1962 groups for all those passing the GME brings out the fact that more students are now passing while still in college. The second portion of the table, limited to undergraduates, shows that among this group there has been a slight decrease in the college level over the four-year period. It also shows that the prize-winners have been further along, on the average, than have the other passing undergraduates. However, it must be pointed out that the prize-winners have

TABLE 4

ACADEMIC STATUS AT TIME OF PASSING GME

Status	All Successful Candidates			Undergraduates Only		
	A 1958 GME	B 1962 GME	C Prize-winners	A 1958 GME	B 1962 GME	C Prize-winners
College graduate	50%	24%	0%	.....	.....	.....
Senior	9	11	25	19%	15%	26%
Junior	15	23	33	34	32	33
Sophomore	14	28	32	32	38	32
Freshman	7	11	9	15	15	9
Other	4	3	1	.....	.....	.....
Average no. of college years completed	.....	.....	.....	2.58	2.46	2.75

shown a consistent downward trend in college level throughout the sixteen-year period. This tendency among both prize-winners and nonprize-winners is consistent with the general higher level of mathematical advancement among modern college students.

Amount of Collegiate Mathematics at Time of Taking the GME

The A, B, and C groups were asked to check off their mathematical advancement at the time of taking the GME. Unfortunately, the highest advancement level printed in the questionnaire was "two or more courses beyond the calculus." It would have been better had there been a greater number of choices, because, as is shown in Table 5, more than half of the students in each group fell into this highest category.

Table 5 shows virtually no change between 1958 and 1962 in the amount of mathematics credited but does show a significantly greater amount of mathematical preparation on the part of the prize-winners

compared with the A and B groups. It is unfortunate that I could not obtain the preparation of those candidates who failed the GME in these same years. It would be very interesting to see whether their formal preparation fell definitely below that of the successful candidates. It is conceivable that there exists a high correlation between success in the GME and the amount of advanced mathematics taken. If so, this could indicate that capable students of good aptitude may be failing solely because they are forced to compete with more advanced students. The Examination Committee, having the files available, might well be urged to undertake such a study.

Adequacy of the Conventional Sequence through the Calculus

The A and B groups of students were asked to check whether, in their opinion, the conventional collegiate mathematics sequence through the integral calculus provided adequate preparation for the GME. This topic has been discussed at Society meetings, and various opinions of members have been expressed. The results are given in Table 6.

There is a clear trend from 1958 to 1962 toward considering the standard courses as more likely to be adequate. This fits in well with the general upgrading of mathematics teaching in recent years as alluded to above.

TABLE 5

MATHEMATICAL ADVANCEMENT AT TIME OF PASSING THE GME

Maximum Advancement	A 1958 GME	B 1962 GME	C Prize-winners
Less than one year of calculus	4%	5%	2%
One year of calculus	19	16	13
One course beyond calculus	19	23	17
Two or more courses beyond calculus	58	57	68

TABLE 6

ADEQUACY OF COLLEGE MATHEMATICS THROUGH CALCULUS FOR THE GME

Opinion	A 1958 GME	B 1962 GME
Completely adequate	30%	47%
Adequate if there is an intensive review	43	37
Needs supplementation	24	14
No reply	4	2

However, one might question the over-all validity of these opinions since, as is shown in Table 5, nearly 80 per cent of the respondents have had at least one course beyond the calculus and might not have been able to judge where they would have stood without the extra courses. It would have been very interesting to compare these opinions with those held by the unsuccessful candidates, had the latter been available.

Number of Trials Required To Pass the GME

Only the nonprize-winning A and B groups were asked to check the number of times which they had tried the GME examination. The results are given in Table 7.

TABLE 7

TRIALS REQUIRED TO PASS THE GME

No. of Trials	A 1958 GME	A 1962 GME
One	57%	74%
Two	25	17
Three or more	17	8
No reply	1	1

It appears evident that the successful candidates in 1962 required fewer trials than did their counterparts in 1958. The cause is not so readily apparent. The improvement could be due to an influx of additional students of superior preparation who pass on the first trial and who thus raise the passing average sufficiently to prevent weaker students from passing even on second or later trials. Or it could be due to a general improvement in ability of candidates in general. It could also be due to the use of a lower passing standard.

PROGRESS BEYOND THE GENERAL MATHEMATICS EXAMINATION

Current Examination Status

Only the A and C groups were asked to check the examinations which they had passed. The question would have been meaningless for the new Fellows and trivial for the 1962 passers of the GME. (This latter group was asked, however, whether they had taken the Probability and Statistics Examination at the same session in which they passed the GME and, if so, with what success. It was found that 21 per cent of the B group respondents did attempt this second examination in 1962 but only 6 per cent passed—a ratio of 29 per cent.) In addition to showing the results for the entire group of prize-winners, the results for the three-year group

1956–58 are also given. This latter group can be more fairly compared with the 1958 GME passers of the A group in regard to subsequent examination progress.

These results show clearly that the prize-winners, in spite of their undoubted ability, do not make as much progress in the subsequent examinations as do the nonprize-winners. Two-thirds of the 1956–58 group of prize-winners did not advance beyond the GME. The record of all prize-winners combined looks better than that of this particular group, but that is due very largely to the success that was had by the initial group of 1947–49. (This is analyzed further on in Table 18 under the subheading "Prize-winners.")

TABLE 8

EXAMINATION PROGRESS BEYOND THE GME

Highest Examination Passed	A 1958 GME	C 1956–58 Prize-winners	C All Prize-winners
Part 2 (GME)	25%	67%	52%
Part 3 (Prob. & Stat.)	18	7	20
Part 4A	14	0	1
Part 4B	17	11	4
Part 5	14	7	4
Part 6	9	4	2
Part 7	2	0	1
Part 8	1	4	16
Average no. of examinations passed	3.17	2.15	2.77

Future Plans of Actuarial Students

Groups A, B, and C were asked to check whether they intended to continue with the examinations, to discontinue, or were undecided. It appears very likely that most of those falling into the "undecided" category will fail to continue. Common sense and experience tend to confirm this view, since it requires strong motivation and will power to pursue this rigorous series of examinations. In Table 9 the four listed categories are shown first in the upper part of the table and are then combined lower down into two groups: those who have achieved their goal or are continuing to strive for it and those who have given up. This combination facilitates the comparison between the three groups, A, B, and C.

The contrast between the A and B groups, on the one hand, and the C group, on the other, is very marked. The small difference between A

and B may well be due to the difference in elapsed time since the GME was passed. That is, some of the 1962 group who will eventually give up have not yet met discouragement through examination failures or been intrigued with other careers. The C group is marked by the "quits." (A further analysis by calendar years of prize-winning appears in Table 18 in the section devoted to the prize-winners.)

TABLE 9

FUTURE EXAMINATION PLANS

Plan or Status	A 1958 GME	B 1962 GME	C Prize-winners
Reached Fellowship	1%	0%	20%
Will continue	58	69	10
Undecided	6	19	6
Have discontinued	35	12	64
Fellowship or continue	59%	69%	30%
Discontinue or undecided	41	31	70

TABLE 10

REASONS FOR DISCONTINUING ACTUARIAL EXAMINATIONS

Stated Reason	A 1958 GME	B 1962 GME	C Prize-winners
Never intended to complete examinations	15%	13%	37%
Examinations too difficult	1	0	1
Lack of time for examination preparation	10	14	0
Length of time required to become a Fellow	5	3	1
Lack of opportunity in the field	5	4	4
Inadequate compensation in the field	1	2	1
Actuarial career less attractive than another	37	54	32
Going into an academic field (usually mathematics)	25	9	24

WHY CAPABLE STUDENTS DISCONTINUE

The students in groups A, B, and C who had replied "No" or "Undecided" on continuance were asked to check their principal reason. There was an opportunity offered for them to write in the reason if none of those suggested was appropriate. These open-end answers fell readily into fairly distinct categories. The results appear in Table 10.

One very striking impression from this table is the relatively insignificant proportions giving face-saving answers, such as "Length of time required to become a Fellow," "Lack of opportunity in the field," etc. Of

course, everyone familiar with the field knows that there is ample opportunity and quite adequate compensation, but it is interesting to learn that even the 1962 GME passers realize this. It *does* take a long time to become a Fellow (see Table 20 below), but this was seldom offered as a reason for quitting. Lack of time for preparation seemed to be somewhat important to a small percentage of both A and B groups but was not mentioned by a single prize-winner.

All three groups gave an important place to the greater attractiveness of other careers or to a disillusionment with the actuarial career. The academic field, usually mathematics but occasionally physics, chemistry, economics, or others, had almost an equal pull on the A and C groups but little on B. This may possibly be explained by the fact that most of the B group are still undergraduates and have not yet felt the lure of graduate work and college teaching and research.

At least a dozen students who have discontinued taking examinations commented at some length on their feelings about the actuarial profession. The following quotations are typical.

> It is my opinion that the actuarial profession has relatively little opportunity to offer the individual with mathematical talent to use that talent. I found my employment as an actuarial trainee with two insurance companies (both summer positions) indicated that I could find far more interesting employment elsewhere.

> After taking the exam, I worked at X Company for four months and found that being an actuary was more a businessman's life than a mathematician's. Since I was more interested in mathematics, I gave up any ideas about an actuarial career, although one can make a good living in it, or so it seems.

> The Society of Actuaries is faced with overwhelming competition for mathematical talent due to ordinary and defense-related research and development efforts—yet actuarial work appears to be more accounting than mathematical, which discourages the mathematically inclined, particularly when there are so many opportunities elsewhere.

It may come as a surprise to learn of the proportion who took the GME without ever intending to complete the examinations. Over one-tenth of the A and B groups and over one-third of the C group fell into this category. In absolute terms, the numbers involved were not large; nevertheless, it is interesting to analyze the group by the initial reason for taking the GME (Table 11).

There are not enough cases to enable one to form definite conclusions, but they do point to some interesting possibilities. One cannot help but notice the number who took the GME merely to satisfy an employer's urging or to gain a higher wage.

CANADIAN AND AMERICAN STUDENTS

As was indicated in some of the foregoing sections, a complete breakdown by country was made on all the questionnaire tabulations.In general, the results for the two countries ran parallel, although in some instances, two of which have already been noted (Tables 1 and 2), they differed appreciably. In a few cases the number of Canadian respondents was too small to warrant further analysis. The distribution by nation for each group appears in Table 12. The uniformity by group is apparent.

TABLE 11

DISTRIBUTION OF STUDENTS WHO NEVER INTENDED TO COMPLETE THE EXAMINATIONS BY REASONS FOR TAKING THE GME

Reason for Taking the GME	A 1958 GME	B 1962 GME	C Prize-winners
To win a cash prize	3	2	16
Examination considered a challenge	0	2	2
Job requirement or encouragement	6	4	8
Other	1	4	3
Total	10	12	29

TABLE 12

DISTRIBUTION OF RESPONDENTS BY NATIONALITY

Nationality	A 1958 GME	B 1962 GME	C Prize-winners	D New Fellows
American	82%	79%	76%	80%
Canadian	18	21	24	20

We have already noted in Table 1 that there are differences between the two countries in the original source of information regarding the actuarial profession. A higher percentage of the Canadian population is engaged in insurance and actuarial work than is the case below the border. Knowledge regarding the professional opportunity seems to have penetrated to the high schools and colleges to a greater extent.

Success in the GME

The two countries differed somewhat on the number of times required to pass the GME. The Canadians held an advantage over the Americans in 1958 and had increased it substantially by 1962 (Table 13).

Academic Status

Another noticeable difference appeared in the academic status at the time of passing the GME. Americans in all three groups—A, B, and C—were somewhat further along in school, on the average, and had had more mathematical preparation. The proportion beyond the sophomore year in college and the proportion who had taken work beyond the integral calculus are shown in Table 14. The results also offer evidence that, on the average, Canadians take advanced mathematics at an earlier stage in college than do their American counterparts.

TABLE 13

NUMBER OF TRIALS REQUIRED ON THE GME BY NATIONALITY

No. of Trials	Group A 1958 GME		Group B 1962 GME	
	United States	Canada	United States	Canada
One	55%	66%	70%	89%
Two	27	17	19	10
Three or more	17	17	9	2
No reply	1	0	2	0

TABLE 14

ADVANCEMENT IN COLLEGE AND IN MATHEMATICS BY NATIONALITY

	A (1958 GME)		B (1962 GME)		C (Prize-winners)	
	United States	Canada	United States	Canada	United States	Canada
Beyond sophomore level	78%	59%	63%	40%	70%	19%
Mathematics beyond the integral calculus	79	66	82	71	89	73

Actuarial Schools

One final point of substantial difference between the students from Canada and from the United States might be noted. The proportion of respondents in each of the four groups from "actuarial schools" is appreciably higher in Canada. (This point is developed further in Table 16 below.)

WOMEN STUDENTS

The computer program was set up to classify all the data by sex of the respondent, but the proportion of women was so small that these tables were of almost no value. The proportion of women in the four groups, A, B, C, and D, was, respectively, 3, 7, 2, and 1 per cent. These results merely bear out the general impression that, despite a few very prominent exceptions, women do not play an important part in the actuarial world. However, the fact that the small proportion writing the GME in 1958 had more than doubled by 1962 may indicate an increasing interest in the profession on the part of women.

TABLE 15

PROPORTION OF NEW FELLOWS AND PRIZE-WINNERS FROM CERTAIN SCHOOLS

School	Proportion of New Fellows	Proportion of Prize-winners
Michigan	15%	3%
Iowa	8	2
Toronto	7	14
Manitoba	6	1
Drake	4	2
Harvard	4	21
Yale	1	7
Massachusetts Institute of Technology	0	3

COLLEGES AND UNIVERSITIES

The respondents in the A group of those passing the GME in 1958 were distributed among 71 different colleges and universities. The B group of 1962 represented 134 schools, nearly double the number of the A group. However, the bulk of the new Fellows came from a relatively small group of schools which, year in and year out, continue to supply nearly half of the new membership of the Society. The distribution of the new Fellows and the prize-winners from 8 selected schools is shown in Table 15.

It is very interesting to notice that the five leading "actuarial schools" top all others in supplying new Fellows but, with the exception of Toronto, are not prominent in supplying prize-winners. This latter honor is taken by schools whose students of pure mathematics seem to have discovered the financial rewards available.

Actuarial Schools

In order to investigate further the relationship between the profession and the so-called actuarial schools, all the colleges and universities men-

tioned in the returned questionnaires were classified into the categories "actuarial" and "nonactuarial." The schools known to have well-established programs providing courses which go at least as far as the Society examination in life contingencies were, in alphabetical order: Drake, Georgia State College, Iowa, Manitoba, Michigan, Nebraska, Texas, Toronto, and Wisconsin. Colleges which offer only a few courses which might be labeled "actuarial" or which have only an occasional student who completes actuarial studies, generally in a special reading course, were not deemed to be actuarial schools for the purposes of this study.

In this connection, Toronto presents a difficult problem. While there is no question whatever as to its right to be called an "actuarial school,"

TABLE 16

PROPORTION OF STUDENTS FROM "ACTUARIAL SCHOOLS"

	United States				Canada			
	A 1958 GME	B 1962 GME	C Prize-winners	D New Fellows	A 1958 GME	B 1962 GME	C Prize-winners	D New Fellows
Actuarial.....	23%	11%	13%	35%	52%	37%	85%	61%
Nonactuarial...	74	84	86	62	48	63	15	39
No college.....	4	5	1	3	0	0	0	0

it seems likely that a number of Toronto students of pure mathematics, with no interest or training in actuarial studies, also take the GME, perhaps solely to compete for the prizes. Since there was no information available on which to base a separation of these Toronto students from the actuarial Toronto students, all were classified as attending an actuarial school. Perhaps the distortion caused by the students of pure mathematics from Toronto being classified as actuarial is responsible for the chief differences between Canada and the United States appearing in Table 16.

If we confine our attention to the United States, we see that the proportion of students from actuarial schools passing the GME was cut in half between 1958 and 1962. Whether this will eventually be reflected in the proportion of new Fellows cannot be determined at this time. Perhaps a better indicator of any such possible trend would be the proportion of students passing one of the later examinations, say, the probability and statistics or perhaps the life contingencies examination. Among the recent new Fellows the actuarial schools accounted for better than one-third.

It should be pointed out that a part of the discrepancy between the proportion of students from actuarial schools in the A, B, and D groups

is due to the method of allocation by school. In this study a student was attributed to the school he last attended. A fair number of students who attend a nonactuarial school at the time of passing the GME transfer later at the junior or graduate level to an actuarial school to complete their education.

The Canadian situation is obviously dominated by the actuarial schools. Owing largely to the Toronto students, the Canadian actuarial schools rank even higher in the C group of prize-winners than in the others. However, the same sort of drop from 1958 to 1962 in the proportion of actuarial students passing the GME occurred in Canada, also, although at a higher level.

PRIZE-WINNERS

In addition to the data obtained from the questionnaire returns from group C, the prize-winners, additional information was obtained from the published records of the Society. The name, year, school, and subsequent examination progress are all readily available for all prize-winners. The availability of this information permitted certain comparisons between all 145 prize-winners and the 110 who replied to the questionnaire. It was found that all but one who had reached the Fellowship replied, so that the other 34 nonreplies were almost all among the drop-outs. A reasonable interpretation would be that many of the tables involving the prize-winner group are thus biased, so that a result more favorable to the prize-winners appears than would likely have been the case had a complete sample been obtained.

Changes in Characteristics from 1947 to 1962

There appears to have been a definite change in the type of prize-winning student from the start in 1947 to the present. This view is supported by the change in subsequent examination progress, in the schools represented, and in the reasons given for taking the examination.

To get at this change over the sixteen-year period studied, the data were broken down into triennial subgroups, starting with 1947–49, except that the fifth subgroup consisted of the final four years covered by the study, 1959–62 (Table 17). Only the instances where a clear change through time is apparent are presented in the following tables.

Progress in Subsequent Examinations

Table 17 indicates fairly clearly that only a small proportion of the recent prize-winners would have taken the examination had no cash prize been offered. Hand in hand with this goes the progress in subsequent examinations, as shown in Table 18.

It is true, of course, that not too much progress could have been expected of the most recent four-year group, but the previous one (1956–58) has had a longer opportunity to make progress than has the A group of students passing the GME in 1958. In spite of this disadvantage, the A group has averaged 3.17 examinations passed as against 2.15 for the highly selected 1956–58 group of prize-winners, who had, on the average, one more year in which to make progress.

The Top Prize-winners

An interesting sidelight is obtained by noting the progress of the 17 top prize-winners, the ones who received the $200 prize in each year. (There are 17 instead of 16 because two top prizes were awarded in 1954.) Only one top prize-winner (1949) has ever gone beyond the second examination (statistics and probability), and he went on very rapidly to the Fellowship, showing what could be done if the desire were present. Of the other 16, 7 passed the second examination and stopped there, while the remaining 9 made no subsequent progress whatever. In fact, not a single top prize-winner since 1954 has ever passed another examination!

TABLE 17

PRIZE-WINNERS INFLUENCED BY EXISTENCE OF THE CASH-PRIZE OFFER IN THEIR DECISION TO WRITE THE GME

Subgroup	Proportion Influenced
1947–49	40%
1950–52	47
1953–55	35
1956–58	54
1959–62	73

TABLE 18

PROGRESS OF PRIZE-WINNERS TOWARD FELLOWSHIP

Subgroup	Average No. of Examinations Credited through May, 1962	Proportion of Fellows
1947–49	4.6	44%
1950–52	3.2	19
1953–55	3.1	18
1956–58	2.1	4
1959–62	1.3	0

Future Examination Plans of Prize-winners

Another indication of the decline in the actuarial interest of prize-winners through the years is given in Table 19.

The tremendous difference in interest in subsequent examinations between the initial triennial group and the others is striking evidence that the early years were atypical. At that time genuine actuarial students were able to win prizes before this kind of student had been squeezed out by the students of pure mathematics looking for money. The most recent group, 1959–62, shows a higher percentage of indecision; this is not unnatural, since many of them are still in school and have not completely committed themselves to a career.

TABLE 19

FUTURE EXAMINATION PLANS OF PRIZE-WINNERS BY YEARS

Subgroup	Fellowship or Continue	Discontinue	Undecided
1947–49.....	60%	35%	5%
1950–52.....	29	71	0
1953–55.....	30	65	4
1956–58.....	17	79	4
1959–62.....	19	65	15

Voluntary Comments by Respondents

Typical comments on the cash prizes are given below.

From the C group of prize-winners:

The prospect of being an actuary became less attractive as time progressed, since I found I was more interested in being a mathematician than a businessman.

As for the reason that I never intended completing the exams, it is merely that I am more interested in mathematics than in a business career and the success therein which is attendant upon the pursuit of this actuarial alchemy.

From the D group of new Fellows:

. . . it is my feeling that the cash awards should be eliminated. They seem to make it more difficult for sincere actuarial students to pass the early exams by attracting disinterested geniuses to these exams. A current survey of past winners and their ultimate accomplishments on actuarial exams would make this evident.

I know personally at least two men who won cash prizes in Part 2 and neither became actuaries. At Harvard the best math students naturally want to go into academic fields and take Part 2 as a possible way of picking up some easy money.

Conclusions

Cash prizes have now been offered for seventeen years. Should they be continued indefinitely without an appraisal of their effectiveness? The possible reasons for offering the prizes are: (1) to make the actuarial profession better known among college students and (2) to induce persons, who otherwise would not do so, to take the GME and thus get started on an actuarial career. The statistics presented in the preceding pages seem to demonstrate that neither objective is being realized to any appreciable degree.

The original idea seemed worth trying. Like the Eighteenth Amendment, it was "an experiment noble in purpose" but a failure. Perhaps one of the following courses of action might be given serious consideration by the Society:

1. Simply abolish the prizes altogether.
2. Award the prizes for success in one of the later examinations, such as Parts 2, 3, or 4 under the new numbering system.
3. Offer a complete remission of all future examination fees in place of the payment of cash. Perhaps a small cash prize could also be paid, but one too small to attract the "ringers."
4. Give the prizes in future installments of, say, $25, each payment contingent upon the passing of a subsequent examination.
5. Provide tuition scholarships payable if the winner enrolls as an actuarial student at one of the schools that offers such a program.

NEW FELLOWS

In addition to the questions common to all the groups, the D group of new Fellows of 1960, 1961, and 1962 were asked questions regarding their schools, the year in which they took their first examination, the number of examination failures they had had, the college courses they had taken, and the examinations they considered most difficult. The results which appeared most interesting and significant and which have not already been shown in the earlier tables (Tables 1, 2, 3, 12, 15, 16) are given in this section.

Length of Time To Attain Fellowship

The lapse of time from the date of the first examination to the last varied from three to thirty-one years. (It should be noted that a three-year interval covers four examination periods.) The over-all mean time required was 9.87 years, a rather surprising figure. Perhaps most persons in the field tend to estimate about eight years. The Canadian Fellows showed a slightly better record than did the Americans.

There are two factors which should be considered in interpreting these

length-of-time-to-the-Fellowship figures. One is the recent trend to take the GME early in one's college career, thus tending to lengthen the time between this examination and the Fellowship. At least this is the case in the nonactuarial schools, where the student is unlikely to go beyond the examination in probability and statistics until his later employment. The other factor is the time lost in military service.

Perhaps the most significant length-of-time figure to use would be the time elapsed between leaving college and attainment of the Fellowship, less any time spent in military, Peace Corps, or similar service. If another questionnaire were to be designed, it should probably elicit this type of information.

TABLE 20

LENGTH OF TIME BETWEEN DATE OF FIRST EXAMINATION AND ATTAINMENT OF FELLOWSHIP

Years	No.	Years	No.	Years	No.	Years	No.
3.....	2	8.....	24	13.....	11	18.....	0
4.....	4	9.....	19	14.....	7	19.....	2
5.....	7	10.....	26	15.....	4	20.....	2
6.....	11	11.....	22	16.....	0	Over 20..	3
7.....	20	12.....	14	17.....	0		
						Total..	178

	United States	Canada	Total
Mean length of time.....	9.97	9.44	9.87
Mean length, excluding cases over fifteen years..	9.31	9.44	9.34

It should be pointed out that the data presented here are quite different from what might have been obtained from a study of, say, all present Fellows who passed their first examination in 1947. If a series of studies were made according to the year in which the first examination was taken, the average length of time might be found to be steadily increasing; but, if the number of enrollments were increasing, a study like the current one could conceivably indicate that the average length of time to obtain the Fellowship was decreasing.

Examination Failures

The new Fellows were asked to report on the total number of times they had failed actuarial examinations, including cases in which they had "taken a flyer" with little or no preparation. As a companion question,

they were asked to give the number of failures excluding the "flyers." The results, broken down by nationality, are given in Table 21.

The results in both types of failures show a slightly lower failure rate for Americans than Canadians. A comparison of the figures indicates that students often sit for examinations for which they are not prepared and with probably little hope of passing. Many undoubtedly feel that the experience of writing under examination conditions is helpful in preparing them for the next year's examinations. Because such a large percentage of the students reported four or more failures, no good estimate of the average number of failures could be made. The questionnaire should have included more than the five categories which were listed. In spite of this drawback, however, the results do show a substantial failure rate even among those candidates who are ultimately successful.

TABLE 21

NUMBER OF ACTUARIAL EXAMINATION FAILURES

No. of Failures	All Failures Included		Excluding "Flyers"	
	United States	Canada	United States	Canada
None	4%	3%	15%	6%
One	9	6	19	17
Two	11	8	18	14
Three	15	8	14	19
Four or more	61	75	34	44

Most Difficult Examination

The new Fellows were asked to indicate the examination which they considered the most difficult. They were also asked to indicate those examinations ranking second and third in difficulty. It was found that there was a considerable dispersion of answers, so that, if all three ranks were combined, a relatively flat distribution resulted. Accordingly, only the distribution of the first choices appears in Table 22.

It is apparent that there are significant differences between the opinions of American and Canadian students. Americans rank Parts 4B, 6, and 8 in that order, whereas Canadians list Part 3 first, followed with Parts 4B, 7, and 8 tied for second place. This difference may be largely due to the difference between the two countries in the proportion of students from actuarial schools where the subject of life contingencies is taught. When an analysis of the data is made by type of school attended by the student,

we find that in both countries students from nonactuarial schools give a decisive first place vote to Part 4B, while students from the actuarial schools in the United States and Canada place this examination only third and fifth, respectively.

Comments on Examinations

Comments on the examinations themselves were numerous. The A and B groups generally discussed the relationship between college courses and the GME, but a few criticized the importance of speed on the preliminary examinations. The Fellows also tended to be critical of the speed requirement, even in the later examinations, and they objected to the memorization required.

TABLE 22

EXAMINATION CONSIDERED MOST DIFFICULT

Examination (Old Numbering)	United States	Canada
Part 2	2%	6%
Part 3	9	22
Part 4A	2	3
Part 4B	31	16
Part 5	6	9
Part 6	23	12
Part 7	8	16
Part 8	19	16

Typical of the comments are the following:

If credit could be given for parts of an exam as is done during a transition period caused by a change in the exam setup, I think this would be helpful. I realize this would entail a lot of bookkeeping, but, as it is now, weakness in one subject out of three or four can cause the loss of an entire year.

It seems that the passing percentage for later exams could be increased somewhat without lowering standards. By the time an individual is writing fellowship exams it should be expected that he will complete the exams, and limiting the passing number to 50 per cent of those writing an exam seems too stringent to me.

I believe that there should not be more than two subjects on any one exam. Under the old syllabus a student could show a reasonable knowledge on all but one subject and because of a weakness in that one subject be forced to repeat the entire exam. I think that in my particular case partial credit on some of the exams would have considerably reduced the total time it took me to pass all the exams. I think the new syllabus is a step in the right direction.

Even in the later parts there is entirely too much emphasis on speed and on assembling prepared solutions (learning by rote) in preparing for the later exams.

You must be a relatively proficient mathematician to pass the early exams, but, once through, you become basically an executive with little contact with mathematics. The first tends to drive off the weak mathematicians who might make good executives, and the second drives off the good mathematicians who do not want to become executives. Unfortunately, I see no way to get around this problem. I do not believe that the exams evolved this way from any conscious design: it's merely that regurgitative knowledge is so much easier to test and measure than any other kind. All the talk about "high standards" is meaningless when it only means high standards of mental regurgitation.

Basically, I feel that the exams are rotten from the standpoint of testing knowledge and that they virtually entirely test one's ability to memorize vast quantities of disconnected facts. If the exams are to serve only as a series of hurdles in the way of potential Society members, I think they are great, but I think the student could almost equally profitably be tested in exhaustive detail in any academic subject.

SUMMARY

Actuarial students learn of the profession primarily through friends and relatives, college teachers, published material, and high-school teachers, approximately in that order. The effectiveness of published material seems to be increasing in the United States but not in Canada. Conversely, the effect of the regional high-school mathematics contests seems to be gaining in Canada, but there has been no change from 1958 to 1962 in the United States. The effect of the cash-prize offer has been negligible.

Students in general take the GME (General Mathematics Examination) because they have been made aware of the profession and have either a definite or a tentative interest in becoming an actuary. Ranking in third place as a reason for taking the examination is the requirement of a job, either summer or permanent. The cash-prize offer has virtually no effect except on the ultimate prize-winners themselves. The desire to win a prize is the chief motivating factor for them, and it is clear that the big majority of them discontinue taking examinations thereafter.

At the time of taking the GME, students average about two years of college work, and nearly 80 per cent of them have taken courses beyond the calculus. There has been a trend recently toward taking the examination at an earlier stage in school. An increasing proportion of students feel that the standard college program through the integral calculus provides adequate preparation for the GME. There has also been a recent trend

toward the student requiring fewer trials, on the average, to pass the GME.

It has been shown that the prize-winners make less progress in the subsequent examinations than do the ordinary students and that the recent trend is toward even less progress. The prize-winners of the first three or four years were atypical and did as well in the subsequent examinations as did the nonprize-winning students.

The principal reasons given for dropping out of the examination program were the greater attractiveness of other careers, chiefly academic careers in mathematics. A surprising number, particularly among the prize-winners, stated that they had never intended to complete the examinations. Very few objected to the compensation or opportunities in the actuarial field or to the length of time required to attain the Fellowship.

For the most part, there are only minor differences in characteristics between Canadian and American students. One of the most noticeable is that a considerably higher proportion of the Canadian students attended "actuarial schools."

There is a great disparity between the proportion of new Fellows and of prize-winners coming from schools which have furnished a substantial number of actuarial students in the past.

The evidence seems to point conclusively to the uselessness of the cash-prize offer. Various alternative suggestions are made.

The new Fellows of the past three years average nearly ten years between the date of the first examination and the date of attaining Fellowship. Over 60 per cent had failed examinations four or more times, but, when examinations for which no reasonable preparation had been made were eliminated, over half of the Fellows had at most two failures. Evidently, the practice of "taking a flyer" at an examination is widespread. The most difficult examination for Americans proved to be the one in life contingencies, followed by Parts 6 and 8. The Canadians found probability and statistics to be the most difficult but with no clear-cut second choice.

Finally, many voluntary comments were made, both critical and constructive, regarding the actuarial profession and the examinations. Some of these comments are quoted above.

This study has provided information on a fairly large scale for the first time on persons who have passed at least one examination but dropped out of the actuarial program. It would be worthwhile to get data from students who failed the GME and thus have never really entered the program. Such a study could be made only by, or with the co-operation of, the Education and Examination Committee because it alone has

access to the names and addresses of those who fail the examinations. It would be very interesting to inquire from those failing candidates their original source of information regarding the profession, the reason why they took the examination, their academic status, and the amount of mathematics which they had taken. It would be worthwhile to learn their opinion as to why they failed, whether because of insufficient study or because their mathematics courses were inadequate. Were they influenced by the cash prize offer? Do they intend to try the examination again? Many more questions could be asked, and doubtless some interesting and valuable conclusions could be drawn.