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ABSTRACT

This report describes a study conducted in response to a request for help in establishing decision rules for exempting prospective teachers from a proposed statewide testing requirement in Indiana. Having decided to use Scholastic Assessment Test (SAT) scores as a basis for exempting prospective teachers from the Pre-Professional Skills Test (PPST), the Indiana Professional Standards Board had to decide how high a score to require on each portion of the SAT as a condition for granting exemption. Data were obtained for nearly 35,000 examinees who took the PPST and the SAT. The statistical technique used to estimate the conditional probabilities was logistic regression. The estimated conditional probability of passing PPST reading and mathematics scores for prospective teachers with SAT verbal and mathematics scores ranging from 300 to 700 was determined. These probabilities are presented in table form. (SLD)

How Well Do SAT Scores Predict Pass/Fail Status on a College-Level Basic Skills Test?

Samuel A. Livingston

This paper is prepared for the:
Annual Meeting of the National Council on Measurement in Education
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Educational Testing Service

A paper to be presented at the annual meeting of the
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The problem

This report describes a study conducted in response to a request for help in establishing decision rules for exempting prospective teachers from a proposed statewide testing requirement. The state was Indiana, and the proposed requirement was that prospective teachers demonstrate mastery of basic reading, writing, and mathematics skills, by earning specified scores on the Pre-Professional Skills Tests (PPST). Exemptions from the reading and math requirements were to be granted to prospective teachers who had achieved specified SAT verbal and mathematical scores (SAT verbal for exemption from PPST reading, SAT math for exemption for PPST math). The Indiana Professional Standards Board reasoned that prospective teachers should not be required to demonstrate basic levels of competency in reading and mathematics on the PPST if they had already demonstrated certain levels of competency.

Having decided to use SAT scores as a basis for exempting prospective teachers from the PPST requirement, the Indiana Professional Standards Board next had to decide how high a score to require on each portion of the SAT as a condition for granting the exemption. Probably the most useful information for making this decision would be a table indicating, for each possible score on the SAT, the probability that a prospective teacher with that SAT score would achieve at least the required score on the PPST. The object of this study was to produce those tables – one for reading; one for math.

Previous research

One published study, by Soules, et al. (1993) investigated the predictive relationship between ACT scores and success on the PPST. That study found ACT scores to be a strong predictor of success on the PPST. Of 521 students in the study, 244 had ACT composite scores of 21 or higher, and all but two of those students passed all three sections of the PPST on their first attempt. Of 11 students with ACT composite scores of 13 or lower, only one passed all three sections of the PPST on first attempt.

The data

The data file that served as input to this study was created by matching two files. One file contained the records of all examinees taking the PPST from September 1994 through August 1997. The other file contained the records of all examinees taking the SAT from January 1977 through December 1995. The criterion for matching records was the examinee's Social Security number. The result of this procedure was a matched file of data from nearly 35,000 examinees who took both the PPST and the SAT. For examinees who had taken either test more than once during the specified time period, only the most recent score was retained in the file. SAT scores

obtained before April, 1995 were converted to the new SAT score scale by means of the conversion table published by the College Board.

The mean SAT verbal score of all examinees in the input data file was 500, with a standard deviation of 93. The mean SAT mathematical score was 491, with a standard deviation of 92. The correlation between SAT verbal scores and PPST Reading scores was .71; the correlation between SAT mathematical scores and PPST Mathematics scores was .78.

One factor that could possibly affect the relationship between SAT scores and PPST scores is the time interval between the two tests. Because of this possibility, the study included analyses conducted separately for subgroups of examinees classified on this variable. The subgroups were defined in terms of calendar years. In this analysis, an examinee who took the SAT and the PPST in the same calendar year is considered to have a time interval of zero years. An examinee who took the SAT and the PPST in successive calendar years was considered to have a time interval of one year; and so on. Figure 1 shows the distributions of this variable, computed separately for PPST Reading and PPST Math. The two distributions are nearly identical. The most common time interval between the SAT and the PPST was two years, but this time interval accounted for only about one-fourth of the examinees. Nearly half the examinees took the PPST four or more years after taking the SAT, and one-fifth of the examinees took the PPST seven or more years after taking the SAT.

The analysis

The statistical technique used to estimate the conditional probabilities was logistic regression, as operationalized in SAS PROC LOGISTIC. Logistic regression assumes that the relationship between the predictor variables (x_1, x_2, ...) and the probability of the event to be predicted (P) can be represented by the equation

$$\log_e\left(\frac{P}{1-P}\right) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots$$

where β_0, β_1, β_2, ... are parameters estimated from the data.

In this study, the only information used in predicting a prospective teacher's probability of passing the PPST was the prospective teacher's score on the relevant portion of the SAT. All the predictor variables were functions of the prospective teacher's SAT score. (Using two or more predictors derived from the same test score allows the predicted probabilities to fit the data more closely.) Five predictor variables were formed, by standardizing the SAT scores and then raising the standardized scores to the first, second, third, fourth, and fifth powers. The five predictor variables were entered sequentially into the analysis. Each predictor was kept in the prediction equation only if it produced a statistically significant decrease in the amount of unexplained variation (statistically significant at the .05 level).

The results

Table 1 and Figures 2 and 3 show the estimated conditional probability of passing PPST Reading and PPST Mathematics, for prospective teachers with SAT verbal or mathematical scores

ranging from 300 to 700. These probabilities are estimated from the data for all 34,000+ examinees in the data file. The estimated conditional probability of passing each PPST test rises from as low as .10 to greater than .99 as the SAT scores increase from 300 to above 600.

Tables 2 and 3 and Figures 4 and 5 show the probabilities estimated separately for groups of examinees taking the PPST 1, 2, 3, 4, 5, 6, and 7 years after the SAT. Figure 4 shows that as the number of years since taking the SAT increases from 1 to 7, there is a systematic increase in the estimated conditional probability of passing PPST Reading, given SAT verbal score. In other words, among prospective teachers having the same SAT verbal score, those who took the SAT longer ago have a higher probability of passing the PPST than those who took the SAT more recently. The probabilities increase steadily with the number of years since taking the SAT. For students in the low-average range of verbal ability, the differences are substantial. An SAT verbal score of 400 implies a .28 probability of passing PPST reading for examinees who take the PPST one year after the SAT, but a .60 probability of passing PPST reading for examinees who take the PPST seven years after the SAT. For examinees with an SAT verbal score of 450, the corresponding probabilities are .58 and .86.

Figure 5 shows the same comparison for the mathematics test. The probability of passing PPST Mathematics, for examinees with a given SAT mathematical score, appears to be related very weakly to the number of years since taking the SAT. For examinees with SAT mathematical scores in the 400-to-450 range, examinees taking the PPST six or seven years after the SAT tend to pass at a slightly higher rate than those taking the PPST earlier. The probabilities of passing the PPST for examinees with SAT mathematical scores of 400 are about .34 for those taking the PPST within 5 years of the SAT and about .39 for those taking it 6 or 7 years after the SAT. For examinees with SAT mathematical scores of 450, the corresponding probabilities are about .65 and .70.

Discussion

It is not surprising that SAT scores predict success on the PPST Reading and Mathematics tests. The unanticipated result of this study has to do with the time interval between the two tests. As a practical matter, the kind of differences shown in Figure 4 may not be of much importance for choosing an exemption score. Making the exemption score depend on the number of years since taking the SAT could be administratively difficult and politically sensitive. Nevertheless, it is interesting to speculate on the reasons for these differences. Do prospective teachers improve in their basic reading skills – but not in their basic math skills – during their college and post-college years? This explanation is plausible. College gives students the opportunity to practice their reading comprehension skills and the incentive to improve them. However, the relationship shown in Figure 4 continues well past the usual college years. Possibly the kinds of work and leisure activities that prospective teachers engage in after college tend to improve their reading comprehension. At the same time, the college courses and post-college activities of prospective teachers may offer little practice – or little incentive to improve – in the kinds of basic mathematics skills tested by the PPST.

Reference

Soules, W. P., Beatty, R. L., and Hopper, T. L. 1993. ACT scores predict success on the Pre-Professional Skills Test. NACADA Journal, 13 (1), 23-26.

Table 1. Estimated conditional probability of passing PPST, by SAT score, estimated for total group.

SAT verbal score	Probability of passing PPST Reading
700	.99+
690	.99+
680	.99+
670	.99+
660	.99+
650	.99+
640	.99+
630	.99+
620	.99+
610	.99
600	.99
590	.99
580	.98
570	.98
560	.97
550	.97
540	.96
530	.94
520	.93
510	.91
500	.89
490	.86
480	.83
470	.79
460	.75
450	.70
440	.65
430	.60
420	.54
410	.49
400	.44
390	.39
380	.34
370	.29
360	.25
350	.22
340	.19
330	.16
320	.14
310	.12
300	.10

SAT mathematical score	Probability of passing PPST Math
700	.99+
690	.99+
680	.99+
670	.99+
660	.99+
650	.99+
640	.99+
630	.99+
620	.99+
610	.99+
600	.99+
590	.99
580	.99
570	.99
560	.99
550	.98
540	.97
530	.96
520	.95
510	.93
500	.90
490	.87
480	.83
470	.78
460	.72
450	.66
440	.59
430	.53
420	.47
410	.41
400	.35
390	.31
380	.27
370	.23
360	.20
350	.18
340	.16
330	.14
320	.13
310	.11
300	.10

Table 2. Estimated conditional probability of passing PPST Reading, by SAT verbal score[1] and years since taking SAT.

SAT verbal	Years since taking SAT						
	1	2	3	4	5	6	7
700	.99+	.99+	.99+	.99+	.99+	.99+	.99+
690	.99+	.99+	.99+	.99+	.99+	.99+	.99+
680	.99+	.99+	.99+	.99+	.99+	.99+	.99+
670	.99+	.99+	.99+	.99+	.99+	.99+	.99+
660	.99+	.99+	.99+	.99+	.99+	.99+	.99+
650	.99+	.99+	.99+	.99+	.99+	.99+	.99+
640	.99	.99+	.99+	.99+	.99+	.99+	.99+
630	.99	.99+	.99	.99+	.99+	.99+	.99
620	.99	.99	.99	.99+	.99+	.99+	.99
610	.99	.99	.99	.99+	.99	.99	.99
600	.98	.99	.99	.99	.99	.99	.99
590	.98	.99	.99	.99	.99	.99	.99
580	.97	.98	.98	.99	.99	.99	.99
570	.97	.97	.98	.99	.98	.99	.99
560	.96	.97	.97	.98	.98	.98	.99
550	.95	.96	.96	.98	.98	.98	.98
540	.93	.94	.95	.97	.97	.97	.98
530	.91	.93	.94	.97	.96	.96	.97
520	.89	.91	.93	.95	.95	.95	.97
510	.87	.89	.91	.94	.94	.94	.96
500	.83	.86	.89	.92	.92	.93	.95
490	.79	.82	.86	.90	.90	.91	.94
480	.75	.79	.83	.87	.87	.88	.93
470	.70	.74	.79	.83	.84	.86	.91
460	.64	.69	.75	.78	.80	.82	.89
450	.58	.64	.70	.72	.76	.79	.86
440	.52	.59	.64	.66	.71	.74	.82
430	.45	.53	.59	.58	.65	.69	.78
420	.39	.47	.53	.50	.58	.64	.73
410	.34	.42	.46	.43	.52	.58	.67
400	.28	.37	.40	.35	.45	.52	.60
390	.24	.32	.35	.28	.38	.46	.52
380	.20	.28	.29	.22	.32	.40	.44
370	.17	.24	.25	.17	.26	.34	.36
360	.14	.20	.20	.13	.21	.29	.29
350	.12	.17	.17	.09	.17	.24	.22
340	.10	.15	.13	.07	.13	.20	.17
330	.09	.12	.11	.05	.10	.17	.12
320	.08	.11	.09	.04	.08	.13	.09
310	.07	.09	.07	.03	.06	.11	.06
300	.07	.08	.06	.02	.04	.09	.04

[1] SAT scores obtained before the 1995 revision to the SAT score scale have been converted to the new scale.

Table 3. Estimated conditional probability of passing PPST Math, by SAT mathematical score[2] and years since taking SAT.

SAT math	Years since taking SAT						
	1	2	3	4	5	6	7
700	.99+	.99+	.99+	.99+	.99+	.99+	.99+
690	.99+	.99+	.99+	.99+	.99+	.99+	.99+
680	.99+	.99+	.99+	.99+	.99+	.99+	.99+
670	.99+	.99+	.99+	.99+	.99+	.99+	.99+
660	.99+	.99+	.99+	.99+	.99+	.99+	.99+
650	.99+	.99+	.99+	.99+	.99+	.99+	.99+
640	.99+	.99+	.99+	.99+	.99+	.99+	.99+
630	.99+	.99+	.99+	.99+	.99+	.99+	.99+
620	.99+	.99+	.99+	.99+	.99+	.99+	.99+
610	.99+	.99+	.99+	.99+	.99	.99	.99
600	.99	.99+	.99+	.99+	.99	.99	.99
590	.99	.99	.99+	.99+	.99	.99	.99
580	.99	.99	.99	.99+	.99	.99	.99
570	.99	.99	.99	.99	.99	.98	.98
560	.98	.98	.98	.99	.99	.98	.98
550	.98	.98	.98	.98	.98	.97	.97
540	.97	.97	.97	.98	.98	.96	.96
530	.96	.96	.95	.96	.97	.95	.95
520	.94	.94	.94	.95	.96	.94	.94
510	.92	.92	.91	.93	.94	.92	.92
500	.90	.89	.88	.90	.92	.90	.90
490	.87	.85	.85	.87	.89	.87	.87
480	.83	.81	.80	.82	.85	.84	.84
470	.78	.76	.75	.77	.80	.80	.80
460	.73	.70	.70	.72	.74	.75	.75
450	.66	.64	.64	.65	.67	.70	.70
440	.60	.57	.58	.59	.60	.64	.64
430	.53	.51	.51	.52	.52	.58	.58
420	.46	.45	.46	.45	.45	.52	.51
410	.40	.39	.40	.39	.38	.45	.45
400	.34	.33	.35	.33	.33	.39	.38
390	.29	.29	.31	.28	.28	.34	.33
380	.25	.24	.27	.24	.24	.29	.27
370	.21	.21	.23	.21	.20	.24	.23
360	.18	.18	.20	.17	.18	.20	.19
350	.15	.16	.18	.15	.16	.17	.15
340	.13	.14	.16	.13	.14	.15	.13
330	.12	.12	.14	.11	.13	.13	.11
320	.11	.11	.13	.09	.12	.11	.09
310	.10	.10	.11	.08	.11	.10	.08
300	.09	.09	.10	.07	.11	.09	.07

[2]SAT scores obtained before the 1995 revision to the SAT score scale have been converted to the new scale.

Figure 1.
Distribution of time interval between SAT and PPST

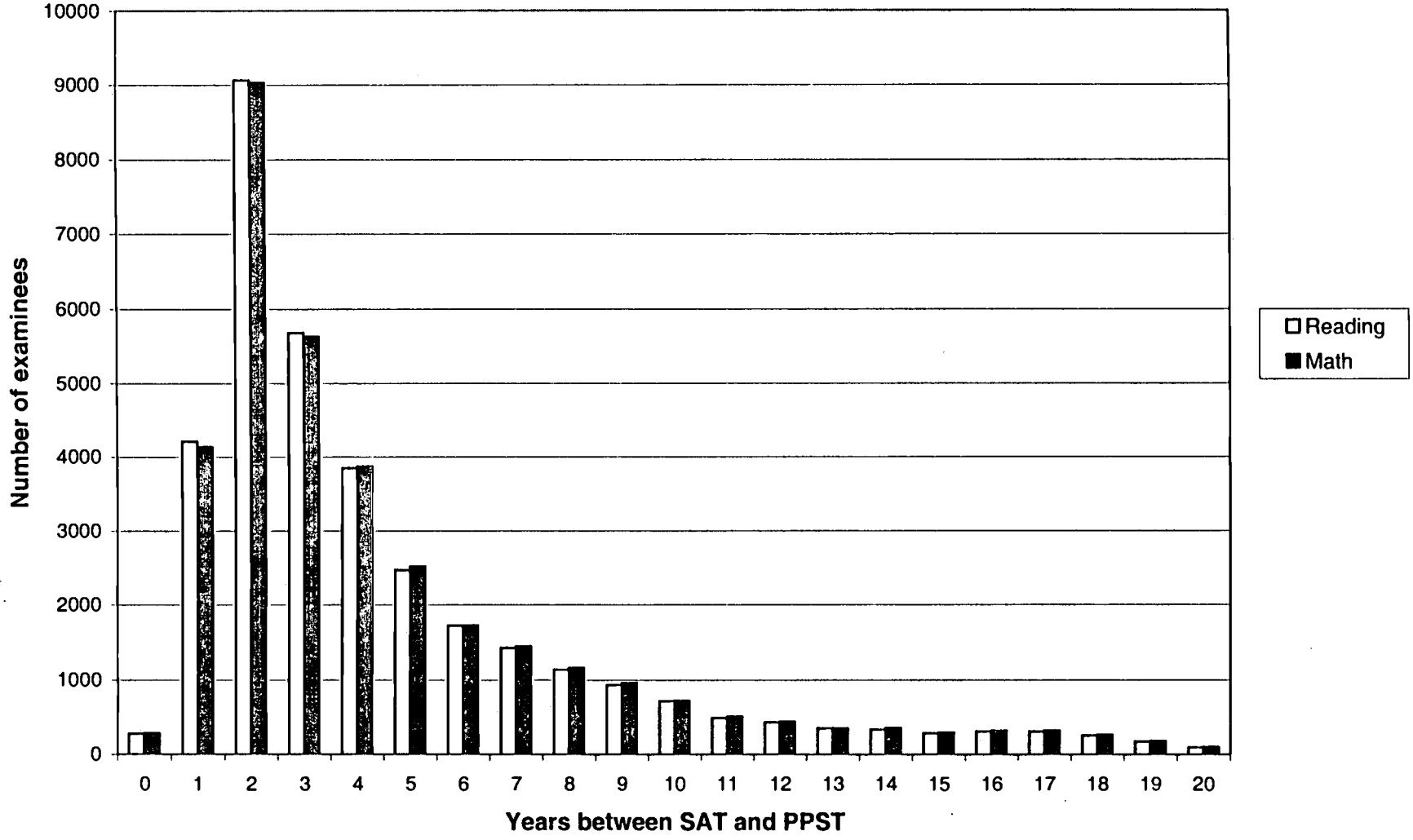


Figure 2.
Estimated probability of passing PPST Reading

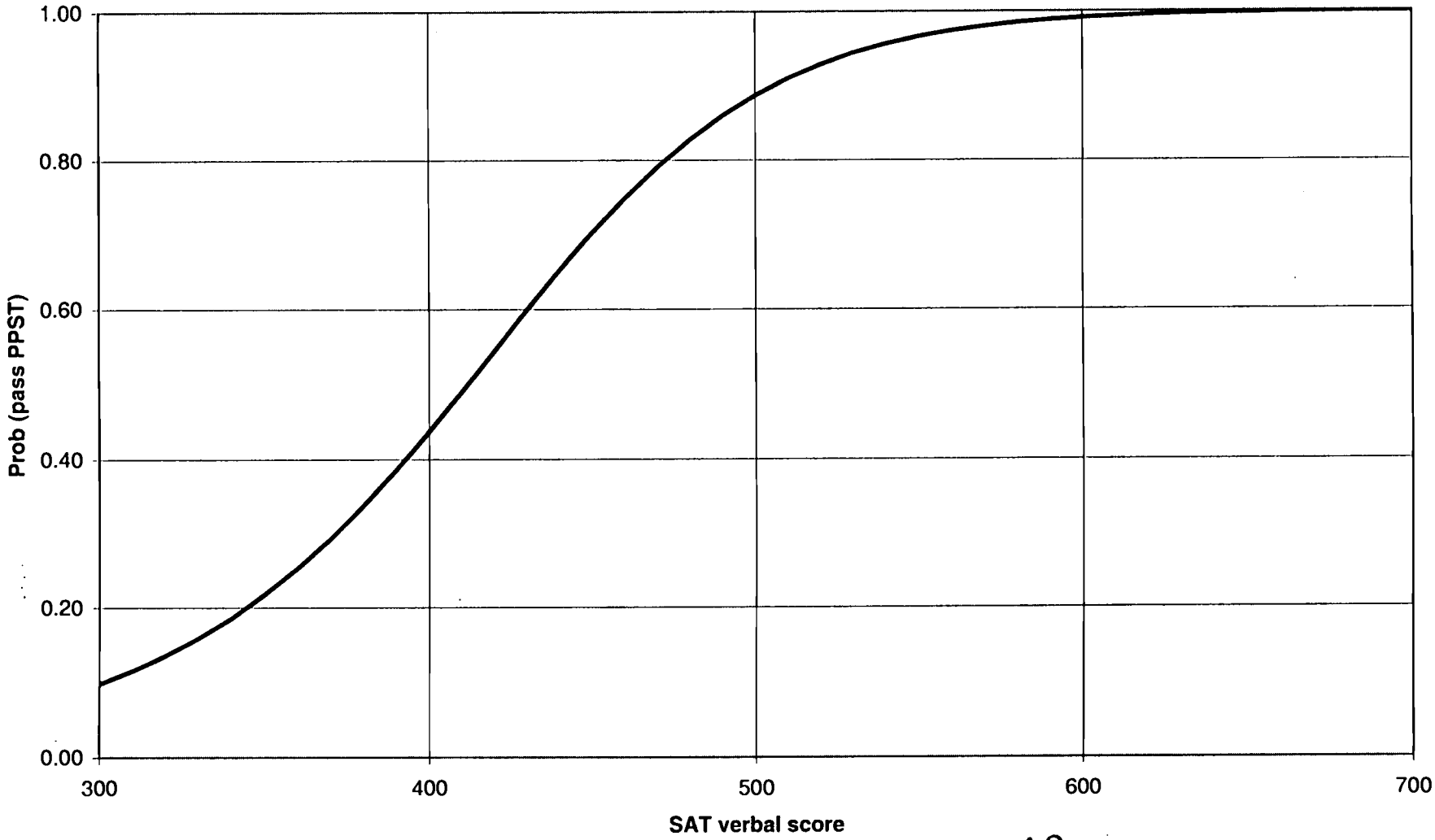


Figure 3.
Estimated probabilty of passing PPST Math

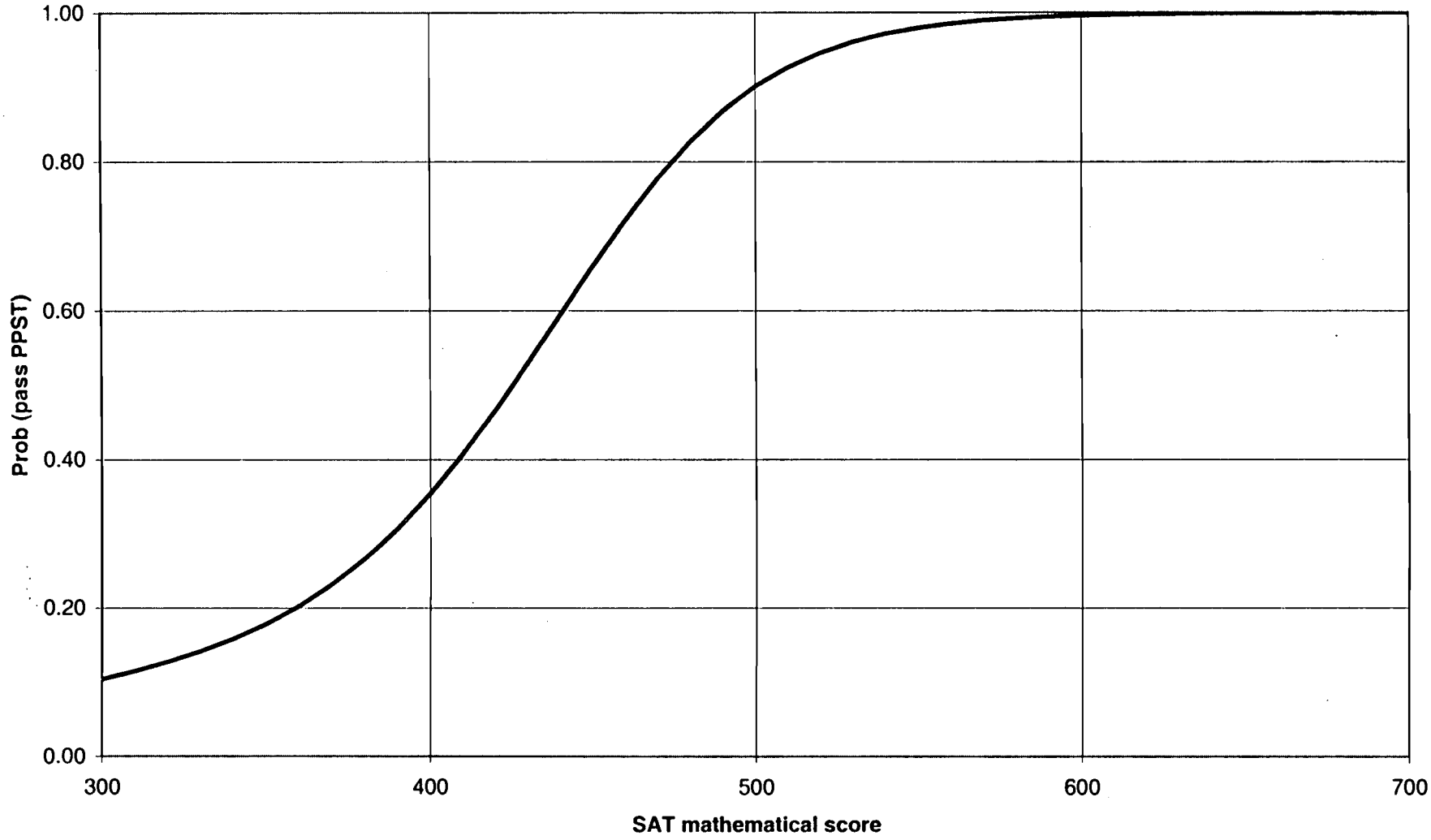


Figure 4.
Probability of passing PPST Reading, by years since taking SAT.

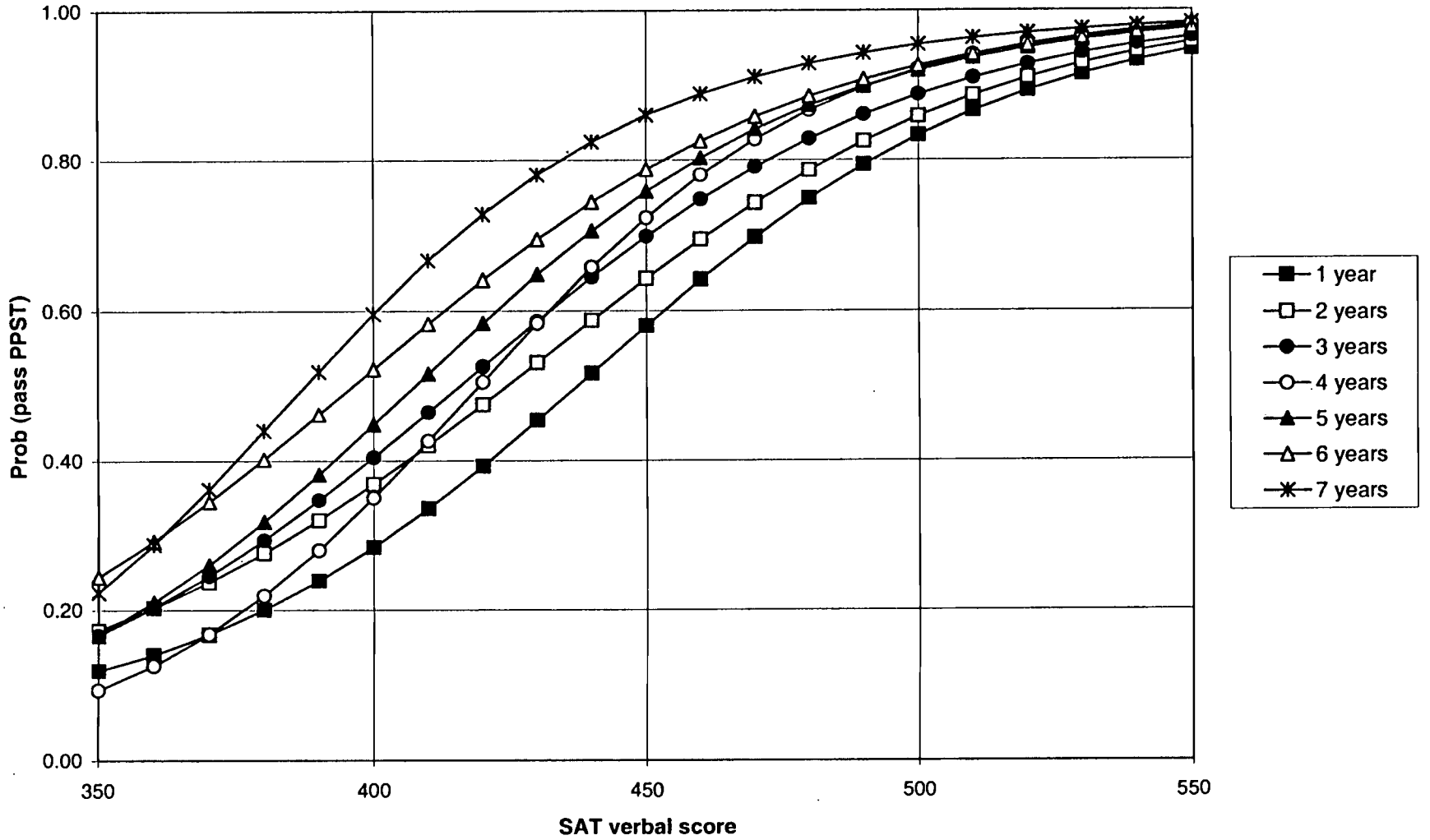
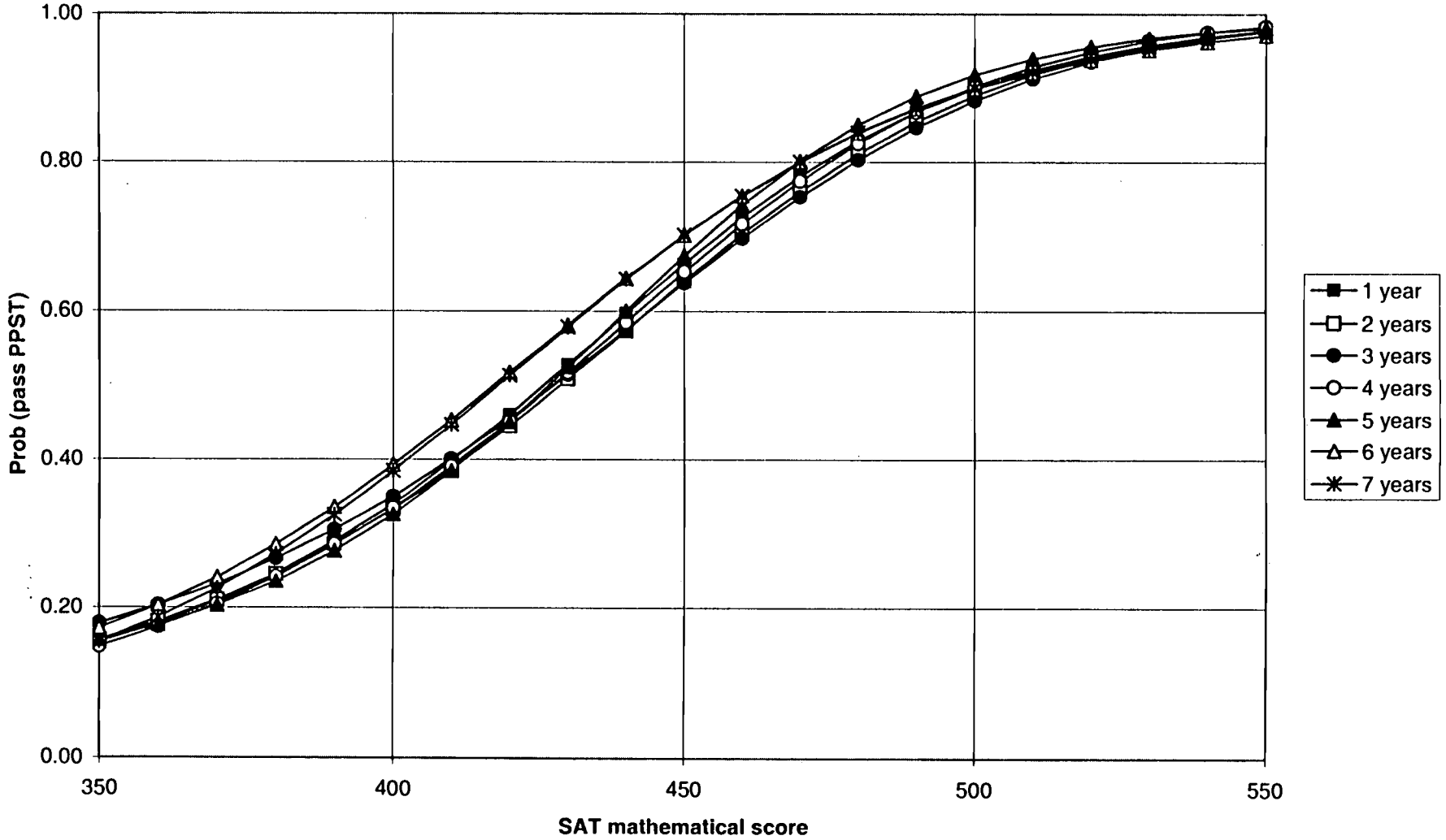


Figure 5.
Probability of passing PPST Math, by years since taking SAT.



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