DOCUMENT RESUME

ED 060 129 TM 001 287

TITLE	Calculating-Machine Operator 216.488; Computer Operator 1-25.13 -- Technical Report on Standardization of the General Aptitude Test Battery.
INSTITUTION	Manpower Administration (DOL), Washington, D.C. U.S. Training and Employment Service.
REPORT NO	TR-S-90
PUB DATE	Sep 56
NOTE	9p.
EDRS PRICE	MF-$0.65 HC-$3.29
DESCRIPTORS	*Aptitude Tests; *Cutting Scores; Evaluation Criteria; Job Applicants; *Job Skills; Norms; Occupational Guidance; Office Machines; *Office Occupations; *Personnel Evaluation; Test Reliability; Test Validity
IDENTIFIERS	Comptometer Operator; GATB; *General Aptitude Test Battery

ABSTRACT

The United States Training and Employment Service General Aptitude Test Battery (GATB), first published in 1947, has been included in a continuing program of research to validate the tests against success in many different occupations. The GATB consists of 12 tests which measure nine aptitudes: General Learning Ability; Verbal Aptitude; Numerical Aptitude; Spatial Aptitude; Form Perception; Clerical Perception; Motor Coordination; Finger Dexterity; and Manual Dexterity. The aptitude scores are standard scores with 100 as the average for the general working population, and a standard deviation of 20. Occupational norms are established in terms of minimum qualifying scores for each of the significant aptitude measures which, when combined, predict job performance. Cutting scores are set only for those aptitudes which aid in predicting the performance of the job duties of the experimental sample. The GATB norms described are appropriate only for jobs with content similar to that shown in the job description presented in this report. A description of the validation sample is included. (AG)

FINAL REPORT

TECHNICAL REPORT

ON

STANDARDIZATION OF THE GENERAL APTITUDE TEST BATTERY

FOR

CALCULATING-MACHINE OPERATOR 216.488

COMPTOMETER OPERATOR 1-25.13

B-339 or S-90

(Supersedes B-219 for Comptometer Operator 1-25.13)

U. S. Employment Service in
Cooperation with
Minnesota State Employment Service

U. S. DEPARTMENT OF LABOR
Bureau of Employment Security
Washington 25, D. C.
September 1956

GATB #2076 and 2090
February 1955

STANDARDIZATION OF THE GENERAL APTITUDE TEST BATTERY FOR COMPTOMETER OPERATOR 1-25.13

B-339 S-90

Summary

The GATB, B-1002A, was administered by the Minnesota State Department of Employment Security to 53 women employed as Comptometer Operators 1-25.13 at eight firms in St. Paul and Minneapolis. These eight firms included two government agencies, two oil companies, two public service firms, one retail trade, and one wholesale drug company. Supervisors' ratings on a descriptive rating scale were used as the criterion.

Two other test development studies on this occupation have been completed. One of these was based on a sample of 63 Comptometer Operators employed at the Pennsylvania Railroad Company, Philadelphia, Pennsylvania. The experimental battery was the GATB, B-1001. The other study was based on a sample of 67 Comptometer Operator students at various schools in Minnesota.

An attempt was made to develop a single set of norms with selective efficiency for the sample in each of the three studies. This attempt was not successful. For several reasons, the Minnesota study on employed workers was chosen as the basis for developing national norms for Comptometer Operator 1-25.13.

GATB Norms for Comptometer Operator 1-25.13 - B-339 S-90

Table I shows, for B-1001 and B-1002, the minimum acceptable score for each aptitude included in the test norms for Comptometer Operator 1-25.13.

TABLE I

Minimum Acceptable Scores on B-1001 and B-1002 for B-339

B-1001			B-1002		
Aptitude	Tests	Minimum Acceptable Aptitude Score	Aptitude	Tests	Minimum Acceptable Aptitude Score
N	CB-1-D CB-1-I	100	N	Part 2 Part 6	95
P	CB-1-A CB-1-L	100	P	Part 5 Part 7	100
Q	CB-1-B	105	Q	Part 1	105
T	CB-1-K CB-1-G	90	K	Part 8	95

Effectiveness of Norms

The data in Table V indicate that 10 of the 18 poor workers, or 56 percent of them, did not achieve the minimum scores established as cutting socres on the recommended test norms. This shows that 56 percent of the poor workers would not have been hired if the recommended test norms had been used in the selection process. Moreover, 29 of the 37 workers who made qualifying test scores, or 78 percent, were good workers.

TECHNICAL REPORT

I. Problem

This study was conducted to determine the best combination of aptitudes and minimum scores to be used as norms on the General Aptitude Test Battery for the occupation of Comptometer Operator 1-25.13.

II. Sample

The General Aptitude Test Battery, B-1002A, was administered between September 9, 1954 and February 2, 1955 to 54 women employed as Comptometer Operators 1-25.13 at eight firms in Minneapolis and St. Paul, Minnesota.

The eight firms included two government agencies, two oil companies, two public service firms, one retail trade and one wholesale drug company. One person was eliminated from the tested sample because criterion data were not obtained. Thus the final sample consists of 53 workers. Workers were selected for this sample on the basis of proficiency on the comptometer as the prime determinant. Fifty-one of the operators are graduates of schools of comptometry; two of the operators received on-the-job training. Tests were not used for selection of the students for admission to the schools, but a high school diploma was usually preferred. Training in the schools consisted of 260 to 300 hours of actual work with the comptometry machine.

The selection factors used by the eight firms in hiring workers and the number of workers from each firm included in the final sample are indicated in Table II.

TABLE II

Selection Factors Used by the Eight Firms and Number of Workers from Each Firm Included in Final Sample

SELECTION FACTOR	FIRM							
	1	2	3	4	5	6	7	8
Performance or Proficiency Test on Comptometer	X	X	X	X		X		
Experience as Comptometer Operator	X		X	X			X	X
Other Work Experience		X			X			X
High School Graduation						X	X	
Comptometry School Graduation		X		X		X	X	X
General Intelligence Test		X					X	X
Clerical Test							X	X
Number of Workers in Samples	5	6	4	6	12	10	2	8

Table III shows the means, standard deviations, ranges, and Pearson product-moment correlations with the criterion for age, education and experience.

TABLE III

Means (M), Standard Deviations (σ), Ranges, and Pearson Product-Moment Correlations with the Criterion (r) for Age, Education and Experience

Comptometer Operator 1-25.13

N = 53

	M	σ	Range	r
Age (years)	32.0	10.9	19 - 56	-.32*
Education (years)	11.9	0.9	8 - 14	-.03
Experience (months)	90.6	83.2	3 - 390	-.13

* Significant at the .05 level

The data in Table III show that the criterion has a significant negative correlation with age but does not have a significant correlation with education or experience. This indicates that in this sample the older workers tend to be less competent than the younger workers and/or the supervisors tended to be biased in favor of the younger workers. The data indicate that the sample is suitable for test development purposes with respect to age, education, and experience.

III. Job Description

Job Title: Comptometer Operator 1-25.13

Job Summary: Operates key-driven ten-bank manually or electrically powered automatic calculating machine to perform all computations necessary for accounting and statistical activities.

Work Performed: Receives business accounts, statistical reports or other material from supervisor, other comptometer operators or clerks. May collect own material from files or other sources. Arranges material neatly on desk or other work platform adjacent to calculating machine.

Depresses proper keys and manipulates levers on automatic calculating machine, using a touch or sight system, to add, subtract, multiply or divide, or extract square root. Reads the answers from a series of figures appearing in window or slots at bottom or top of machine.

Calculates or checks the figures on such records as inventories, financial reports, pay-rolls, balance sheets, invoices, discounts, sales and statistical reports. Frequently refers to charts, rate books or tables specialized to industry. Routes completed material to the next work station or returns it to file.

IV. Experimental Battery

All of the tests of the GATB, B-1002A, were administered to the sample group.

V. Criterion

Supervisors' ratings were used as the criterion. The ratings were made on a descriptive rating scale which included items considered important for successful job performance. An attempt was made to include in the scale items which would reflect actual ability to perform without regard to personality or work habit factors. The rating scale has nine items, each with five alternatives numbered from 1 to 5. A rating of "1" indicates very low performance and a rating of '5' indicates very high performance. The total score on the scale is the sum of the numerical ratings on the nine items.

The supervisor in each company was instructed to rate his workers in comparison with "comptometer operators in general" rather than only in relation to each other. This instruction was given to help insure comparability of the ratings made by the various supervisors.

The supervisors provided re-ratings two weeks after making the original ratings. The correlation between first and second ratings was .86, indicating satisfactory rating consistency.

The criterion used for validation purposes was the sum of the scores obtained on the first and second ratings. The mean criterion score for the sample of 53 workers was 63.4, with a standard deviation of 13.0, and a range of 31 through 86.

VI. Statistical and Qualitative Analysis

Table IV shows the means, standard deviations and Pearson product-moment correlations with the criterion for the aptitudes of the GATB. The means and standard deviations of the aptitudes are comparable to general working population norms with a mean of 100 and a standard deviation of 20.

TABLE IV

Means (M), Standard Deviations (σ), and Pearson Product-Moment Correlations with the Criterion (r) for the Aptitudes of the GATB

Comptometer Operator 1-25.13

N = 53

Aptitudes	M	σ	r
G-Intelligence	111.2	13.7	-.06
V-Verbal Aptitude	108.7	13.7	-.15
N-Numerical Aptitude	112.0	11.5	.05
S-Spatial Aptitude	103.2	19.0	-.19
P-Form Perception	112.1	19.1	.10
Q-Clerical Perception	120.6	13.2	.21
K-Motor Coordination	117.1	16.2	.43**
F-Finger Dexterity	112.1	18.6	.21
M-Manual Dexterity	102.4	19.8	.24

** Significant at the .01 level

The statistical results were interpreted in the light of the job analysis data. The job analysis indicated that the following aptitudes measured by the GATB appear to be important for this occupation:

Numerical Aptitude (N) - required for understanding arithmetical and computational processes and checking the correctness of machine computations.

Clerical Perception (Q) - required for comparing numerical data on machine with data on records and reports, and for accuracy in using charts, tables, and rate books.

Motor Coordination (K) - required for coordinating eyes and fingers rapidly and accurately when entering numerical data in the machine and for operating the machine rapidly and accurately.

Finger Dexterity (F) and Manual Dexterity (M) - required for manipulating keys, moving levers, and setting decimal places on the machine, and for manipulating a pencil and thumbing through forms, tables and reports.

The highest mean scores in descending order of magnitude were obtained for Aptitudes Q, K, P, F and N, respectively. All of the aptitudes have standard deviations of less than 20. Aptitude Q has the lowest standard deviation.

For a sample of 53 cases, correlations of .35 and .27 are significant at the .01 level and the .05 level of confidence, respectively. Aptitude K correlates significantly with the criterion at the .01 level. None of the other aptitudes has a significant correlation with the criterion.

Aptitudes N, P, Q, K, F and M were considered for inclusion in the test norms on the basis of the qualitative and quantitative evidence cited above. All of these aptitudes, except P, appear important from the qualitative analysis of work performed; Aptitudes N, P, Q and K have relatively high mean scores; and Aptitude K has a significant correlation with the criterion.

Tetrachoric correlations were computed between various sets of trial norms and the dichotomized criterion. To compute the tetrachoric correlations, the criterion was dichotomized so that approximately one-third of the sample was placed in the low group. The trial norms consisted of various combinations of Aptitudes N, P, Q, K, F and M with appropriate cutting scores. As a first approximation, cutting scores for the aptitudes in the trial norms were set at one standard deviation below the aptitude means and rounded to the nearest five-point score levels. The cutting scores were then adjusted to the five-point score levels close to these points which resulted in the best selective efficiency for the norms. The results of this analysis showed that norms of N-95, P-100, Q-105 and K-95 had better selective efficiency than any other set of norms tried. The cutting score for each aptitude in these norms is within ten points of one standard deviation below the aptitude mean.

VII. Concurrent Validity of Norms

For the purpose of computing the tetrachoric correlation coefficient between the test norms and the criterion and applying the Chi Square test, the criterion was dichotomized so that approximately one-third of the sample would be in the low group. The low group consists of workers with criterion scores of 57 or less.

Table V shows the relationship between test norms consisting of Aptitudes N, P, Q and K with critical scores of 95, 100, 105 and 95, respectively and the dichotomized criterion. Workers in the high criterion group have been designated as "good workers" and those in the low criterion group as "poor workers."

TABLE V

Relationship between Test Norms Consisting of Aptitudes N, P, Q and K with Critical Scores of 95, 100, 105 and 95, Respectively and the Criterion for Comptometer Operator 1-25.13

N = 53

	Non-Qualifying Test Scores	Qualifying Test Scores	Total
Good Workers	6	29	35
Poor Workers	10	8	18
Total	16	37	53

$r_{tet} = .61$ $\quad X^2 = 6.599$

$\sigma_{r_{tet}} = .23$ $\quad P/2 < .01$

The data in the above table indicate a significant relationship between the test norms and the criterion for this sample.

Data were also available for a sample of 63 Comptometer Operators tested in 1948 with the GATB, B-1001, in Pennsylvania and for a sample of 67 Comptometer Operator students tested in 1954-55 with the GATB, B-1002A, in Minnesota. Analyses were conducted in an attempt to develop one representative set of norms which would provide good selective efficiency for each of the two Minnesota Samples and the Pennsylvania Sample. This attempt was unsuccessful. Although different sets of norms could be developed which would show good selective efficiency for the three samples, no single set of norms provided good selective efficiency for each of the three samples. For the following reasons, it was decided to use the Minnesota study on employed workers rather than either of the other two studies as the basis for developing national norms for Comptometer Operator 1-25.13:

1. The workers in the Minnesota employed worker study are probably more representative of currently employed Comptometer Operators than the students in the Minnesota study sample or the workers in the Pennsylvania study conducted in 1948.

2. The experimental battery for the Minnesota study on employed workers was the latest edition of the GATB, B-1002; the experimental battery for the Pennsylvania study was B-1001.

3. The statistical results obtained in the Minnesota employed worker study appear to be more in accord with the qualitative analysis of the job than the results of the two other studies.

VIII. Conclusions

On the basis of mean scores, correlations with the criterion, job analysis data and their combined selective efficiency, Aptitudes N, P, Q and K, with minimum scores of 95, 100, 105 and 95, respectively, are recommended as B-1002 norms for the occupation of Comptometer Operator 1-25.13. The equivalent B-1001 norms consist of N-100, P-100, Q-105 and T-90.

Since the experimental sample for this study consists solely of Comptometer Operators and includes 53 employed workers, whereas the experimental sample which served as the basis for the development of Aptitude Test Battery B-219 includes only 32 employed workers who were not primarily Comptometer Operators but performed the duties of several jobs, it is recommended that the norms developed on the basis of this study supersede the B-219 norms for the occupation of Comptometer Operator 1-25.13.

IX. Determination of Occupational Aptitude Pattern

When the specific test norms for an occupation include four aptitudes, only those occupational aptitude patterns which include three of those four aptitudes with cutting scores that are within 10 points of the cutting scores established for the specific norms are considered for that occupation. None of the existing 22 occupational aptitude patterns meet these criteria for this study. However, the data for this sample will be considered for future groupings of occupations in the development of new occupational aptitude patterns.

Since the occupation of Comptometer Operator was listed under Occupational Aptitude Pattern Number 12 on the basis of the results of the B-219 study, and since the B-219 norms for Comptometer Operator have been superseded by the norms resulting from the present study, it is recommended that the occupation of Comptometer Operator be deleted from the group of occupations listed under OAP-12.