AUTOCAD INSTRUCTION IN THE GEOGRAPHY CURRICULUM

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ABSTRACT   A survey of AutoCAD users was conducted in order to determine the appropriateness of the program for the graduate curriculum in geography at Hunter College. How widespread is the use of AutoCAD? Who uses AutoCAD? How is the program used? What other programs are being used? What operating system is used? How did the users learn to use the program? How useful would it be to have people trained in AutoCAD when they apply for jobs? What is the future of AutoCAD in these fields? One hundred field-related businesses and agencies were randomly selected. A questionnaire was mailed to each organization. Of the respondents, 67 percent use AutoCAD. The primary use for the program is cartography, which was identified by 48 percent of responding users; 70 percent of the users employ the AutoCAD program exclusively. On average, among the firms using AutoCAD, eight people use the program in each firm.

Most firms report that AutoCAD was learned by using a combination of several methods. Of respondents, 81 percent trained their personnel to use AutoCAD, 40 percent received previous training in school; 30 percent were trained at another job; and 3 percent paid their employees to take an outside course to learn the program. Most significantly, on a scale of one to ten, where one indicates "not useful" and ten denotes "indispensable," previous training in AutoCAD received an average of 6.2 among respondents. Thus, although most training currently occurs in-house, it is evident that a majority of respondents (77 percent) would prefer to have their employees proficient in the use of AutoCAD prior to coming to work for them.

The results of the survey indicate that AutoCAD is a popular and well-used program. Nonetheless, it is not universally learned in school, since most employers use on-site training. The importance of previous training was cited by almost eight out of ten respondents. Based on the results, the Department of Geography at Hunter concluded that students should be trained in computerized mapping techniques and in the use of AutoCAD in particular.

The complexity and variety of maps using both quantitative and qualitative data often requires sophisticated computer programs to make the mapping task more efficient and effective. This is particularly true when linking data bases and maps in order to solve complex environmental and technological problems. As the use of computers becomes more widespread, the well-trained geographer must be versed in computerized mapping techniques.

In the continuing desire to stay current, the Department of Geology and Geography at Hunter College frequently reviews its software. Among the most publicized programs in the software market have been CADD programs. AutoCAD's publishers claimed in 1986 to have "more users than all mainframe and dedicated minicomputer CADD systems combined."[1] Such a broadly distributed package may be a necessary addition to the curriculum. Given that the Department of Geology and Geography is committed to giving its students the most current and relevant training, more and more classroom time is devoted to computerized applications. It is now a matter of which programs to use rather than whether students will use any programs. Therefore, a survey of firms was designed to see how much AutoCAD is being used and for what purposes.

The Survey

To select firms that were prospective employers of Hunter College students, a content

analysis of current geography, engineering, remote sensing, and cartography journals was conducted to determine relevant firms and government agencies on a nationwide sample. Out of approximately two hundred and fifty firms, one hundred potential field-related businesses and agencies were randomly selected. Those selected represented a cross-section of firms from different geographic regions of the country. A questionnaire was mailed to each organization and the results were tabulated for this report. Of the forty-one firms that responded, twenty firms listed cartography as a primary activity. Some firms listed more than one primary activity: Eleven respondents listed GIS as a primary activity; nine listed photogrammetry, and eight listed engineering (see Appendix 1). (For a summary of results, see Table 1.)

How widespread is the use of AutoCAD? Who uses AutoCAD? How is the program used? What other programs are being used? What computer operating system is used? How did the users learn to use the program? How useful would it be to have people trained in AutoCAD when they apply for jobs? What is the future of AutoCAD in these fields? This study addresses these and related questions.

AutoCAD Usage

Of the respondents, 68 percent use AutoCAD. The primary usage for the program is cartography, which was identified by 50 percent of responding users. In addition, respondents also used the program for GIS (32 percent), engineering (22 percent), and photogrammetry (25 percent) (see Fig. 1).
Significantly, 70 percent of the users employ the AutoCAD program exclusively. The remainder use other programs in addition to AutoCAD, including MAPS 300, ARCINFO, ESRI, INTERGRAPH, and MICROMAP.
All of those using the program do so under the MS-DOS operating system. In addition, a small percentage of respondents also use other operating systems: Unix (7 percent), MAC2 (3 percent), DEC VMS (3 percent), and Sun OS (3 percent) (see Fig. 2). The use of DOS is consistent with wider industry research showing that about 450,000 active DOS-based CADD systems are in use, and up to 700,000 in total including inactive software licenses.[2] Some of the reasons for the predominance of DOS in the CADD world include the complexity of the UNIX operating system, the bias against the Apple Macintosh due to early inadequacies, and the relative simplicity of DOS for entry-level users and small businesses.[3]

Table 1.   **AUTOCAD SURVEY:**
             Summary of Results

68% of respondents use AutoCAD

On average, there are 8 users per firm

79% of firms use in-house training

8 out of 10 firms prefer prior training

53% of respondents plan to increase AutoCAD use
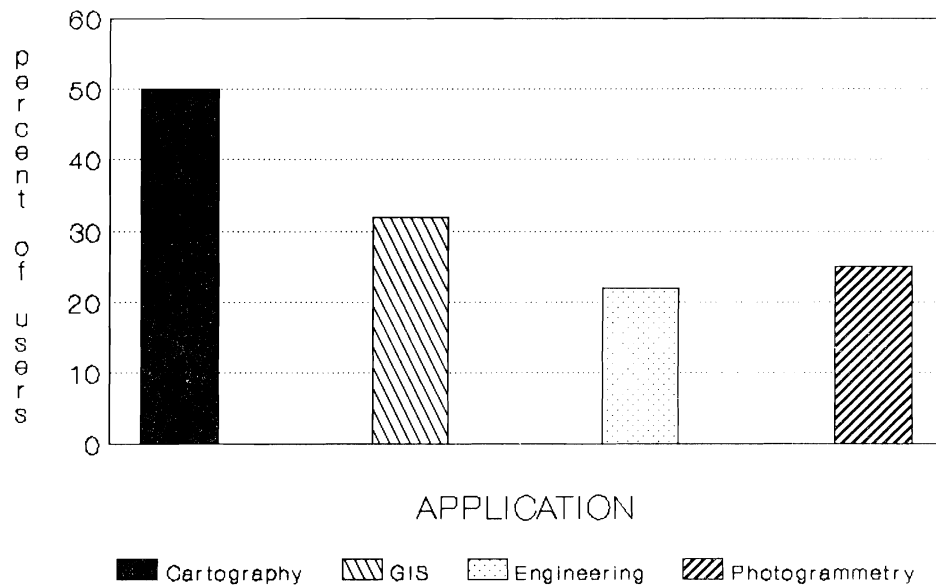
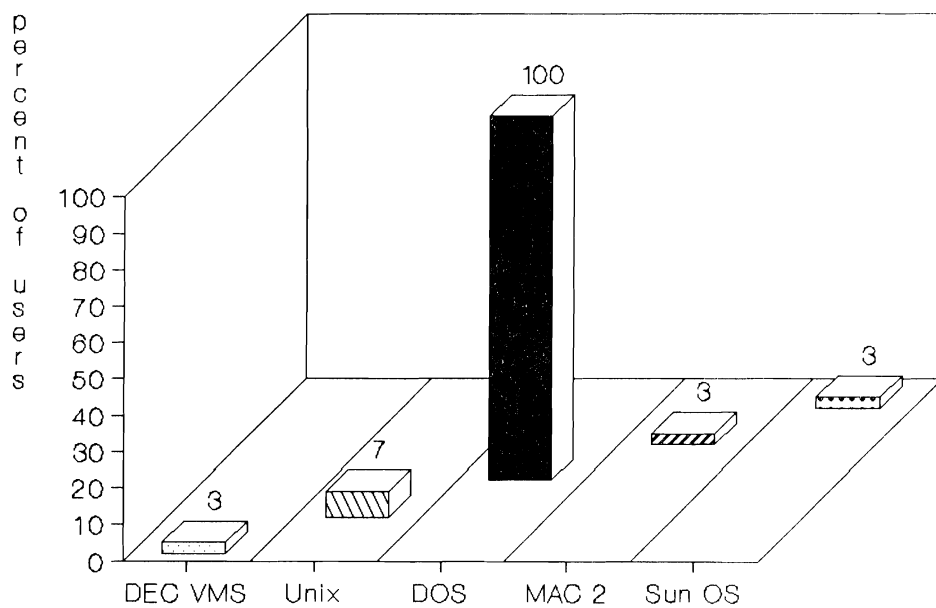# AutoCAD Usage

Figure 1

OPERATING SYSTEM

Figure 2

AutoCAD Users

Among firms using AutoCAD, the mean usage is eight people. This ranges from a high of thirty users to a low of two users in a single firm.

Most firms report that AutoCAD was learned by using a combination of several methods (see Fig. 3).

79%	of respondents trained their personnel to use AutoCAD.
39%	received previous training in school.
32%	were trained at another job.
3%	paid their employees to take an outside course to learn the program.

Most significantly, on a scale of one to ten, where one indicates "not useful" and ten denotes "indispensable," the usefulness of previous training in AutoCAD received an average of 6.14 among respondents (see Fig. 4). Thus, although most training currently occurs in-house, it is evident that a majority of respondents (78 percent) would prefer to have their employees proficient in the use of AutoCAD prior to coming to work for them (see Fig. 5).

Expanded Use

Of the respondents, 54 percent indicate plans to expand their usage of AutoCAD. Of these, 27 percent intend to increase the number of users, while an equal number foresee expanding the number and type of applications of the program, and 46 percent intend to increase both number of users and applications.

Site License

Among respondents, 35 percent already have a site license for AutoCAD, while 11 percent intend to get one, and 3 percent are undecided. This indicates that they are serious about using the program on a wide-scale basis within their firms and not simply for one-time or unique needs.

Comments

Of the respondents, 46 percent included commentary. They ranged from a modest:
We only use [AutoCAD] for data conversion for our AutoCAD clients,
to a dynamic:
finding more people familiar with AutoCAD will also increase our use of it.

The following summarizes the typical comment:
AutoCAD is a good basic system. One course should bring a student to an adequate level to be productive using most CAD systems with minimal on-the-job instruction.

AutoCAD and the Geography Curriculum

In itself, the AutoCAD program offers a variety of interesting and useful features. The full range of grid and snap capabilities allows the user to assign different X and Y spacings, as well as relocate, rotate, or change them into an isometric mode. One can use the standard single hatched and crosshatched patterns, or customize a hatch pattern of one's own. It is also possible to enter geometry in absolute, relative, or polar coordinates. AutoCAD also lets one select the unit of measure that one wants to use and permits one to change it at any time during the drawing.
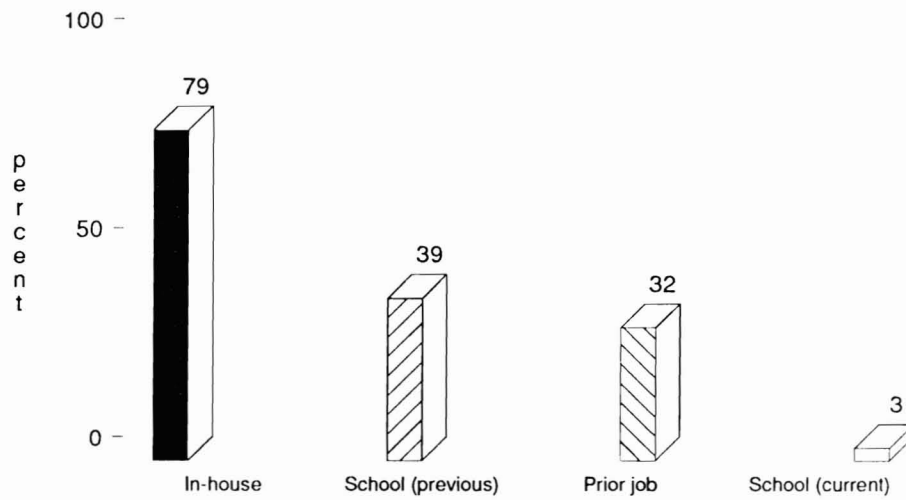
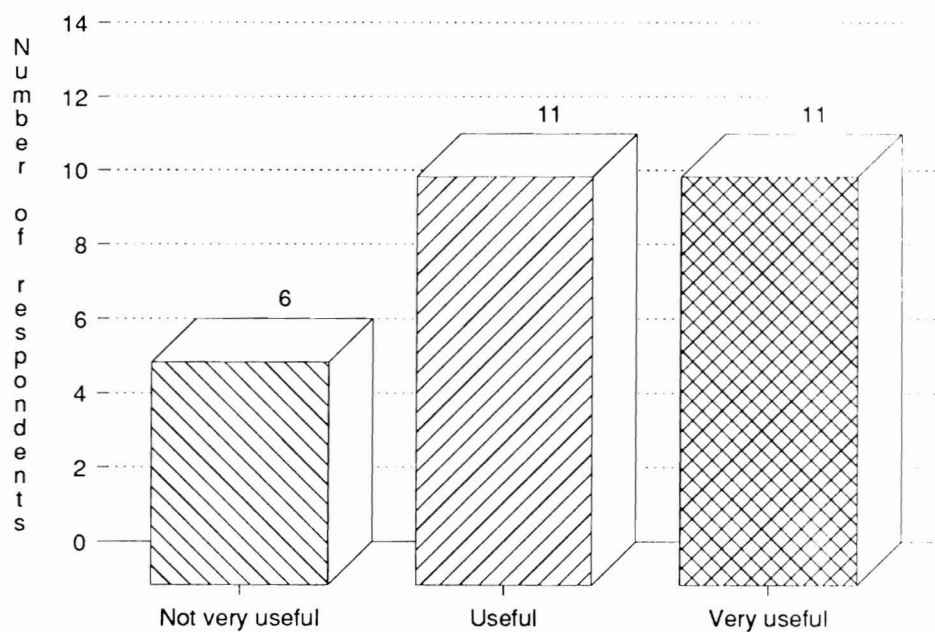# AutoCAD Training

Figure 3

Prior AutoCAD Training

Figure 4

Training Preference

Prefers pre-training
78.5

Employer will train
21.5
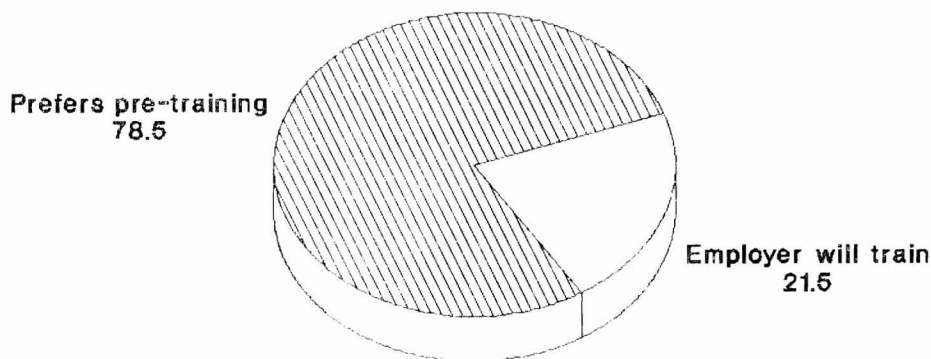
Figure 5

AutoCAD provides over 120 commands that can also be used at any time. For instance, one can execute any command- stretch, trim, explode, zoom, extend -after completing and saving the drawing.

AutoLisp, AutoCAD's internal programming language, enables one "to create custom commands, which can prompt and instruct the user, provide choices and defaults, and make logical decisions."[4]

In addition to the power and versatility of AutoCAD's drawing editor, many add-on and companion programs are also available. (See Appendix 2 for a partial listing.) One such program is AutoShade, a color-rendering software package that can "turn an AutoCAD drawing into a three dimensional shaded image in true perspective" and also "generate stereo pairs (crossed-eye or stereoscopic) for 3-D viewing."[5]

General Applications

AutoCAD can be integrated easily into a geography department's curriculum because of the program's unique flexibility. For various courses it is possible to list specific uses and benefits of AutoCAD. For:

Automated Cartography. Some of the benefits of AutoCAD in the production of computer-generated maps are obvious. To name a few:

1.   Custom hatching and precision spacing techniques will prove to be a valuable tool when drawing a choropleth map;
2.   Unique mapping symbols can easily be created on a large scale and then "zoomed down" to the smaller, more applicable scale;
3.   The 3-D effect created by the AutoShade package would certainly

enhance contour lines on a topographic map.
Principles of Photogrammetry and Air Photo Interpretation. AutoShade could generate stereo pairs of maps quickly and inexpensively. They could be used in conjunction with aerial photographs, which would allow the student to see the image from another perspective.
Computer Programming for Geographic Applications. AutoLisp would add another programming method specific to geographic and cartographic applications.

Conclusion

The results of this survey indicate that AutoCAD is a popular and well-used program. Nonetheless, it is not universally learned in school, since most employers use on-site training. Of most significance is that the importance of previous training was cited by almost eight out of ten respondents. Consistent with the claims of its publisher, the implications of the widespread use and need for training in AutoCAD should be clear to any geography program.

NOTES

[1] Jack Manno, "Drawing Without a Pencil," Data Training, December 1986.

[2] Terry Wohlers, "Environmental Awareness," Computer Graphics World, August 1989.

[3] Ibid.

[4] D. Raker and H. Rice, Inside AutoCAD (Thousand Oaks, Calif.: New Riders Publishing, 1988), pp.13-14.

[5] "Specifications--AutoShade" (Sausalito, Calif.: Autodesk, Inc., 1988).

APPENDIX 1

1. Questionnaire

2. Results of Survey

HUNTER COLLEGE

Dear Sir or Madam:

The Department of Geology and Geography at Hunter College is considering the teaching of AutoCAD to its students. A working knowledge of AutoCAD's drawing editor may be useful in preparing graduating students in cartography and Geographic Information Systems (GIS) for today's job opportunities. In order to determine whether adding the teaching of AutoCAD is worthwhile, we are conducting a survey of firms like yours.

We would like to know whether you use AutoCAD or if you intend to use it, how you use it, and, if not, why not. We would greatly appreciate <u>your</u> answers to the following:

1. What is the primary activity of your business/agency?

(1)
- /a/ Architecture
- /b/ Engineering
- /c/ Consulting
- /d/ Public Agency
- /e/ Cartography
- /f/ GIS

(1g)
- /g/ Other (Please specify)_____

_____

(2)2. Does your business/agency use AutoCAD?   YES / /   NO / /

A. If no, please give a reason. For example:

(2A)
- /a/ We are not familiar with AutoCAD.

- /b/ We are using another program.

(2Ab')
- Which one? _____

- /c/ AutoCAD is not applicable to the kind of work we do.

(2d)
- /d/ Other (please explain) _____

_____

IF YOU ANSWERED "NO" TO QUESTION 2, THE SURVEY IS OVER. PLEASE RETURN THE QUESTIONNAIRE IN THE ENCLOSED ENVELOPE.

3. What operating system do you use on your computers that use AutoCAD?

	/a/	MS-DOS or compatible
	/b/	UNIX or XENIX
(3)	/c/	MAC-2
	/d/	DEC VMS
	/e/	Sun OS
	/f/	Apollo AEGIS
(3g)	/g/	Other_____

(4)4. How many people in your business/agency use AutoCAD? _____

5. For what purpose do they use AutoCAD? (CHECK ALL APPLICABLE)

	/a/	Architectural Design/Drafting
	/b/	Cartography/Mapping
(5)	/c/	Civil Engineering
	/d/	Electrical Engineering
	/e/	Land use plans
(5h)	/h/	Additional____ /f/ GIS

                          /g/ Photogrammetry

6. How did your AutoCAD users learn to use it? (PLEASE MARK ALL APPLICABLE)

	/a/	Previous training in school
	/b/	Previous training in another job
(6)	/c/	Training in this agency/business
	/d/	Unknown
(6e)	/e/	Other _____

(7)7. Do you plan to **expand** your use of AutoCAD?   YES / / NO / /

A. If yes, how? (PLEASE MARK ONE OR MORE)

(7A)	/a/	More users
	/b/	More and different applications
(7Ac)	/c/	Other_____

                                                          .

(cont.)

B. If no, please explain. For example:

(7B)	/a/	We are satisfied with current usage.
	/b/	It is difficult to find persons adequately trained in the use of AutoCAD.
	/c/	We are switching to another program.

(7Bc')   If so, which one? _____.

(7Bd)   /d/   Other_____

_____.

8. Do you have, or do you expect to get, a site license for AutoCAD?

(8)	/a/	Already have site license
	/b/	Intend to get a site license
	/c/	Do not need a site license

(9)9. How useful would it be to have people trained in AutoCAD when they come to work for you? (PLEASE CIRCLE APPLICABLE NUMBER)

Not useful   ---->   **Indispensable**

  0   1   2   3   4   5   6   7   8   9   10

(10)10. Any other comments?

_____

_____

_____.

(11)11. Do you want a copy of the survey results?   YES /   / NO /   /

THANK YOU FOR PARTICIPATING IN THIS SURVEY. PLEASE RETURN THIS QUESTIONNAIRE IN THE ENCLOSED ENVELOPE.

Firm #	(1) Primary Activity	(1q) Other	(2) Use Autocad	(2A) Reason Not	(2A') Which one	(2d) Other	(3) Operating System	(3q) Other	(4) Number Of Users	(5) Purpose	(5h) Additional
1	e		y				a		6	a,b	Business Graphics
2	b	Photogr	y			MAPS300	a		3	b	Photogram
3	e		y			Intergraph	a		6	b	map layouts
4	f		y				a,b		10	e	GIS
5	e		y				a		12	b	
6	f		y				a		5	e	GIS
7	g	photogr	y				a		5		Photogrammetry
8	e,f		y				a		4	b,e	DXF,IGES fmts GIS
9		photogr	y			Kork	a		3		Photogrammetry
10	b		y			Microstation	a,d		10	c,e	
11	e		y				a		2	b	
12	b	sftwre de	y				a		12	d	
13	e		y				a		3	b	data conversn
14	b		y				a		10	b	Photogrammetry
15	b,c,e,f		y				a		20	c,e	GIS
16	b	photgr	y				a		3	b	Photogrammetry
17	e		y				a,e		10	b	
18	e,f		y			ARC/In,ESRI,INT	a		20	e	GIS
19	d,e,f		y			ARC/Info,MOSS	a,c		5	b,e	GIS
20	e,f		y				a		5		GIS
21	b		y				a		11	c	survey mapping
22	e		y				a		3	b	
23		photogr	y				a,b		4		Photogrammetry
24	f	geology	y			Calmo CADD	a		4		GIS
25		photogr	n	b	Intergraph						
26	f	photogr	y			Micromap,in-hse	a		10	e	Photogr.GIS
27	e		n	b	Intergraph						
28			n	c							
29	e,f		n	b	Microstation						
30	b,c		n	b	VersaCad						
31	e,f		n	c							
32	e		n	a							
33	e		n	b	Intergraph						
34	e		n	planning to use							
35		photogr	y				a		3	d	
36		real esta	n	c							
37			n	b	in house dev.						
38		govt.info	n	c							
39	d		n	b	Versacad						
40	e		y				a		4	b,c	
41	e		y				a		30	b	

Total resp.41

yes   28/41   (68.0%)   a 28   a   1
excl. 20/28   (71.4%)   b 2   7.964285714   b 14   f 9 (GIS)
conj. 8/28   (28.5%)   c 1   c+d 6   g 7 (photogr)
no   13/41   (31.7%)   d 1   e   8
      (plan 1)   e 1

Firm #	(6) Learn	(6e) Other	(7) Plans to Expand	(7A) If Yes, How?	(7Ac) Other	(7B) If No, Why?	(7Bc') Name	(7Bd) Other	(8) Site License	(9) Training Useful	(10) Comments	(11) Copy
1	c		y	a,b					a	5	n	n
2	c		y	b					a	8	y	y
3	a		n			c	Intergraph		c	8	n	y
4	b,c		n			a			a	6	y	n
5	c		y	a,b	expand lisp routines				a	8	y	y
6	a,b		y	a,b					b	9	n	n
7	a,b,c		y	a					c	6	y	y
8	c		y	a,b	stereo-compiler				a	6	n	y
9	c		n			a			c	8	y	y
10	a,b,c		n			c	MicroStat.Palette		c	3	y	y
11	a,c		n			a			c	3	y	y
12	a,b		y	b					?	8	n	y
13	c		n			a		no.of acad clts	c	2	n	n
14	a,b		y	a					b	9	n	y
15	c		y	a,b					b	5	n	n
16	a,c		y	a					a	7	y	n
17	e	co paid c	y	a,b					c	8	y	y
18	c		y	b					c	7	y	y
19	c		n			a			a	8	y	y
20	a,c		n			a			a	8	y	y
21	a,b,c		y	b					c	6	n	y
22	c		y	a,b					c	7	n	y
23	b		n			a			a	3	n	y
24	c		n			c	GE Calma CADO		a	2	n	n
25											n	n
26	c		n			a					y	y
27						a			c	5	n	y
28												
29												
30												
31												
32												
33												
34												
35	c		n			a			c	2	n	n
36												
37												
38												
39												
40	c		y	a					c	10	n	y
41	a,b,c,		n			a			c	5		n

a 11 (39%)		y 15 (54%)		a 10
b 9 (32%)		n 13 (46%)	a 4	b 3
c 22 (79%)	paid	exp. 54%	a+b 7	c 14
e 1 (3%)	—outside		b 4	undecided 1
	college			

(0-4) 6 22%
(5-7) 11 39%
(8-10)11 39%
aver.   6.142857142

APPENDIX 2

PARTIAL LIST OF AUTOCAD ADD-ON AND COMPANION PROGRAMS*

Contour Plus
>A program that enables the user to perform contour calculations with amazing speed and accuracy.

GWN-DTM
>The Digital Terrain Model that provides powerful mapping and design capabilities to demanding users of many engineering, survey and mapping disciplines. In addition to the BASE Module's generation of triangulated terrain models (TTMs) and contours, additional modules provide automated design features including profiling, X-sections, full 3-D display, structural and surface volumetrics, isopach TTM generation and slope analysis.

PCMS
>An integrated system for mapping and modeling of spatially oriented data. Its applications include: hydrographic and topographic contouring, pollution studies, land-use analysis, and other applications where surfaces must be constructed and displayed.

Contour Pac
>The Maptech Contour Pac is an easy-to-use program for creating contour maps from random 3-dimensional coordinate points. Coordinates may be generated by the Maptech Survey Pac or transferred from many other sources, including the HP 80 series and HP 71B computers, and a wide variety of data collectors.

Facility Mapping System for AutoCAD
>FMS/AC is a user aid which transforms AutoCAD into a comprehensive Automated Mapping /Facilities Management System. This package enables AutoCAD operators to easily establish and use an intelligent map database suitable for meeting all mapping-related facility management requirements.

COGO-PC Plus
>A powerful easy to use microcomputer-based coordinate geometry program used by engineers to sole geometric problems in such fields as: field surveying, mapping, highway/roadway design, subdivision design, parcel and tract maps, map checking, utility alignments, construction staking and layout, and subterranean mapping.

Geologic Mapping Symbols
>This product consists of symbols libraries developed for use with AutoCAD. The symbols are based on ANSI (American National Standards Institute) standards and have been used throughout industry for many years.

CPS/PC
>This is an advanced contour mapping software system that is designed for reading in random (x,y,z) ASCII data files, creating a grid (a mathematical model of rows and columns with "z" values at each row/column intersection), and then converting this grid to graphic output, such as contour maps, isometric displays, raised contours, ceiling plots, profiles, etc.

* Reprinted from **AutoCAD Applications Catalog** 1988

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Miller, Alan R. The ABC's of AutoCAD. Alameda, Calif.: Sybex Inc.,1988.

Raker, Daniel, and Harbert Rice. Inside AutoCAD. Thousand Oaks, Calif.: New Riders Publishing, 1988.