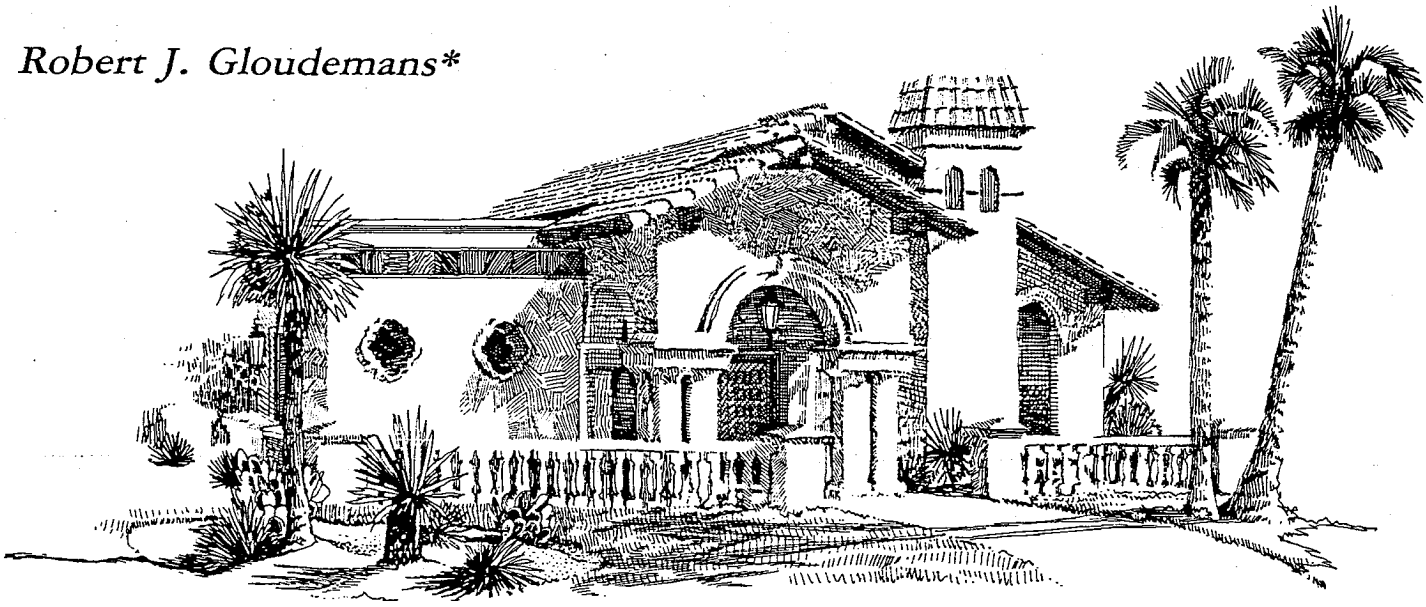
Using General Purpose Software in Mass Appraisal: Do Your Own Thing

*Robert J. Gloudemans**



General purpose software extends great flexibility to the user of a computer system. In contrast to hard-coded or preprogrammed software that was written to support the particular requirements of a particular user at a particular time, general purpose software permits the user to define file structures, mathematical calculations, program algorithms and procedures, and report formats. General purpose software opens new vistas to the developers and users of computer-assisted appraisal systems. This paper outlines the nature, advantages, and limitations of general purpose software in computer-assisted appraisal and discusses two highly successful experiences, one involving Arizona's mass appraisal system and the other a statewide sales ratio study in Colorado.

Mr. Gloudemans is administrator of research and equalization for the Arizona Department of Revenue.

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The Rising World of General Purpose Software

General purpose software has been developed for all levels of computer systems from mainframes to microcomputers. At the mainframe and minicomputer level, common applications include data base management programs and general purpose statistical software. General purpose software is, however, particularly dominant at the microcomputer level due, in part, to its very low cost. There are hundreds of firms developing and marketing this software, resulting in high competition and low prices to users. Although at first it was difficult to exchange data between software packages, many packages now provide links between the most popular packages.

Computer networking has provided an added boost to general purpose microcomputer software. Upload/download capabilities between mainframes and microcomputers let the user take advantage of the storage capabilities of the host computer while performing query and analytical operations at the microcomputer level with general purpose software. Such networking, which greatly facilitates research and analysis, is evolving rapidly.

In any case, regardless of the size and configuration of the computer on which it is run, general purpose software has the following advantages.

1. *Powerful.* The more notable packages come ready to perform highly complex operations usually requiring extensive programming. The large market for these products permits the software developer to amortize costs of development, which may be in the millions of dollars, over a large number of users.

2. *Flexible.* The software supports a great variety of functions, options, and applications, which allows the user to test alternative approaches to problem solving and to modify existing programs with little effort.

3. *Pretested.* Because the software is extensively tested before release, it is usually accurate and reliable.

4. *Well documented.* Documentation is good or excellent. The user's manuals are well written and often there are on-line help screens and "help lines" that the user may call for special assistance.

5. *Easy to Use.* Ease of use follows in part from good documentation. In addition, many vendors provide tutorial disks. General purpose software is often menu driven, allowing the user to select functions and options with a single keystroke. No special background or programming knowledge is required. In general, a user can start on a specific project after investing only several hours in reading the manual and, perhaps, working through the tutorials.

6. *Inexpensive.* The software is usually very inexpensive, particularly compared with hard-coded software. Typical costs range from a few hundred to a thousand dollars for systems performing a variety of functions. Many good single-purpose packages can be had for $150 or less. The vendor will generally make new versions or releases available to existing users for a nominal cost.

7. *User Independence.* All of the above make the user less dependent on outside or specialized expertise. There is less need, if any, for a professional programming staff, and operations are less affected by the loss of a particular programmer or other staff member. In general, modifications to existing systems can be made with little difficulty.

On the other hand, general purpose software has some disadvantages in comparison with hard-coded software. The user must customize, or adapt, generic software to specific needs and requirements. Although this presents few problems in traditional, single-purpose applications, it can be challenging when an entire system, such as a mass appraisal system, is being designed. The speed and efficiency of general purpose software suffer because of the presence of unused functions and options.

On balance, general purpose software is ideal for many standard computer operations (word processing, graphics, statistical analysis, and so on) and offers opportunities for systems design and development for those willing to devote the resources necessary to understand the software and adapt it to their needs.

General purpose software can be either vertical or horizontal. Vertical software is written for a specific industry, business, or application such as accounting, hospital management, or appraisal. Horizontal software is written for a general function such as data management, word processing, statistics, or graphics. A software package that combines a number of general functions is called an integrated package, and there are many of these on the market. The software used in the two case studies described below are examples of horizontal (sometimes integrated) software.

Case Study: Arizona Mass Appraisal System

Arizona was one of the first states to install an automated mass appraisal system (1973), a multiple regression system developed by a mass appraisal firm for the annual reappraisal of most residential properties. In 1977, a statewide sales ratio system, again developed by a private vendor, was added.

In 1980, the existing mass appraisal system was replaced by a new system composed of some general purpose software and some in-house, hard-coded programs. The general purpose statistical software package, *SPSS (Statistical Package for the Social Sciences)*, was used for market research and the development of multiple regression analysis (MRA) equations. Application programs, including value calculations and reports were developed in-house with the assistance of the data processing staff.

Regression equations were not used directly for valuation purposes but were converted to the Base Home Approach. In the Base Home Approach, the typical home in an area is identified and its value computed using the regression model. A table of component adjustments is then derived from the regression coefficients, indicating how much to add or subtract for differences from the typical or "base" home. Initially, base home adjustments and component adjustments were determined manually by the user (Gloudemans 1981; 1985).

The Arizona Department of Revenue, Division of Property Valuation and Equalization, is now converting most of the hard-coded application programs to a general purpose system, using the mainframe version of *SPSS* supplemented by general purpose microcomputer software (Fruitman & Chizewsky 1987). Although initiated because of cutbacks in programming support, the conversion is now seen as valuable in itself. Benefits include the opportunity to make system improvements that have been on hold and the creation of a means to make future system improvements more easily.

Conversion began with the sales ratio system. In Arizona, sales ratio studies are produced quarterly. The system computes three measures of central tendency and corresponding measures of dispersion by various property groups. Results are reported by county, market area, and other geographic breakdowns, along with statewide totals. The latest study used 104,426 sales from an eighteen-month period (thirty months for commercial properties). Division staff have used mainframe *SPSS* to produce results equivalent to those produced by the hard-coded sales ratio system and several improvements, including the computation of confidence intervals about the median sales ratio. Figure 1 shows one such report.

In addition, statistical reports are supplemented with graphics produced on a microcomputer with Microsoft *Chart*.

SPSS has been used to develop MRA-based appraisal models since 1980. The statistical package is also used in a number of other research and development applications. One is the plotting of sales data and the subsequent development of time adjustment factors using MRA and other statistical analyses. Figure 2 contains an example of a plot of sale price/appraisal ratios versus date of sale, the first step in the development of time adjustments.

To the delight of all concerned, the computation of base home values and component adjustments has been automated using *Lotus 1-2-3*. The user enters the base home characteristics and regression coefficients and *Lotus* generates the resulting base home value and market component adjustments (figure 3).

We plan to convert the entire sales ratio and sales-based models systems to general purpose software, but data maintenance, the cost approach, and the division's other appraisal and assessment application programs will continue to be hard-coded. Upload and download capabilities with the mainframe should lead to additional applications of general purpose software, which currently includes *SPSS-PC, SPSS Data Entry,* Microsoft *Chart,*

Figure 1
Example of a Sales Ratio Report

DATE : 13 JUN 88
REPORT: GEN3650-03

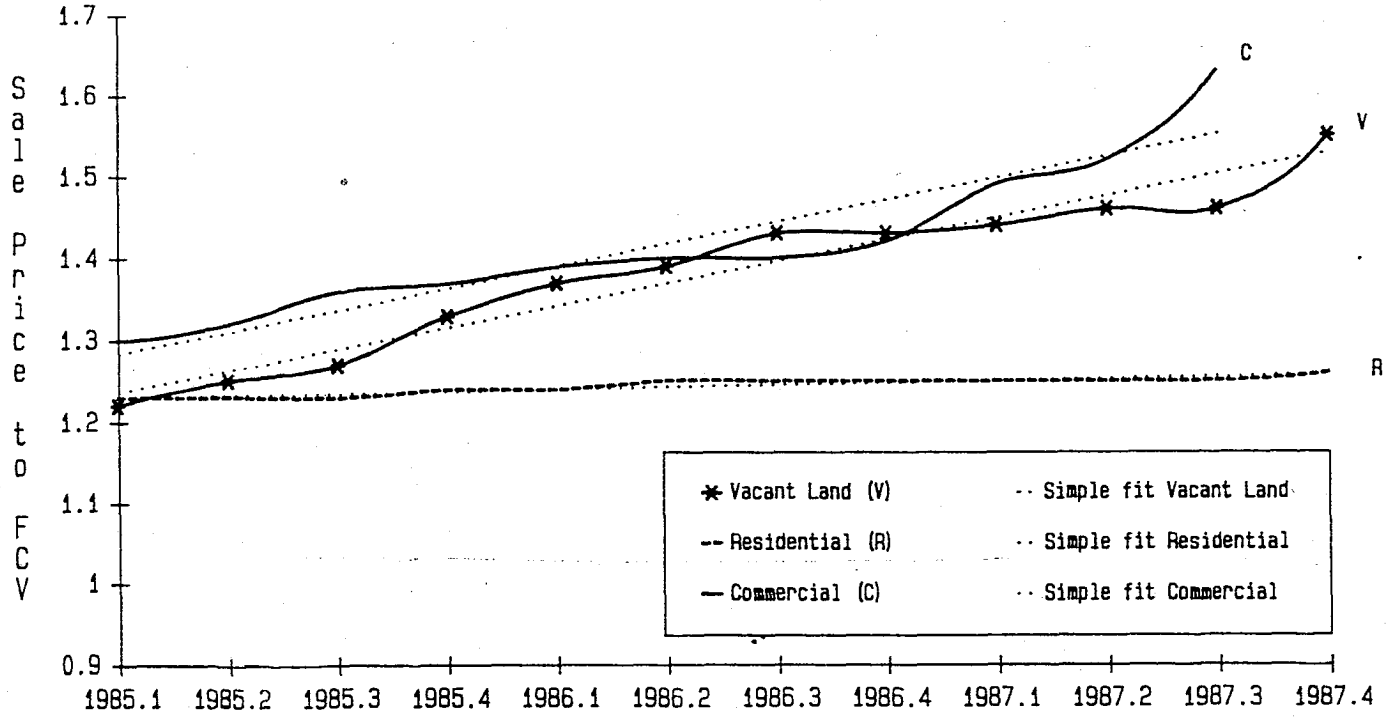
APACHE COUNTY
SUPPLEMENT TO THE CURRENT
SALES RATIO SYSTEM REPORTS

MARKET	PROPERTY TYPE	TOTAL SALES	SALES IN STUDY	MEDIAN	LOWER 95% CONFIDENCE LIMIT OF MEDIAN	UPPER 95% CONFIDENCE LIMIT OF MEDIAN	MEAN	WEIGHTED MEAN	COEF OF DISP	COEF OF VAR	WEIGHTED C.O.V.	PRICE RELATED DIFF	AVG. LAND RATIO
ROUND VALLEY	VACANT	795	745	.795	.778	.800	.806	.718	20.8	29.4	33.6	1.122	.999
	RESDENTIAL	357	159	.791	.759	.821	.817	.786	19.8	28.0	24.2	1.040	.180
	COMMERCIAL	10	5	.449	*	*	.676	.488	71.1	64.0	70.1	1.386	.251
ST. JOHNS	VACANT	922	853	.805	.783	.813	.826	.753	21.5	29.0	27.3	1.096	.999
	RESDENTIAL	182	69	.852	.770	.896	.875	.824	20.9	27.9	23.1	1.062	.147
	COMMERCIAL	2	2	.791	*	*	.791	.886	29.0	41.0	33.4	.893	.175
UNASSIGNED	VACANT	10	10	.687	.480	.853	.695	.722	19.2	21.7	20.7	.964	1.000

NOTE: STUDY EXCLUDES SHOPPING CENTERS, GOLF COURSES, MOBILE HOMES SUBJECT TO AFFIDAVIT OF AFFIXTURE, AND AGRICULTURAL PROPERTY.
AZDOR/DPVE/RE/CAAU

* INDICATES DATA NOT AVAILABLE

Figure 2
Property Value Trends,
Maricopa County



SMART (integrated horizontal software package), *Lotus 1-2-3*, and Harvard *Total Project Manager*.

Case Study: Colorado Sales Ratio System

Colorado conducts a biennial sales ratio and equalization study. The study is conducted by a private contractor, selected from those who respond to a request for proposals. The latest study, conducted in 1987, used only general purpose software and microcomputers for a study of some 25,000 sales from all of Colorado's sixty-three counties (Gloudemans & Thimgan 1987). In general, the study conformed to IAAO's *Standard on Assessment Ratio Studies* and also included confidence intervals and statistical tests where underappraisal was suspected. Results were reported by type of property, size, age, and price ranges. Software used included *SPSS-PC, SPSS Data Entry, Lotus 1-2-3, dBase III*, and Microsoft *Chart*.

SPSS Data Entry was used to create customized on-line data entry screens (figure 4). In many cases data were entered directly onto floppy disks in portable computers at the assessor's office and then transferred to the hard disks of larger capacity microcomputers at the home office in Denver. In some cases data were downloaded from mainframe or minicomputers using *SPSS*'s or other file transfer protocols. User customized on-line and batch edits were used to "clean" the data before further analysis.

The sales ratio reports contained standard measures of central tendency and dispersion, along with the standard error of the mean ratio, which were reported by various property categories depending on type of property (residential, commercial, or vacant; fig-

Figure 3
Base Home Value and Market Component Adjustments

1987 SALES BASED MODELS COMPONENT ADJUSTMENT TABLE FOR CENTRAL MOHAVE COUNTY 13-Jun-88

REGRESSION COEFFICIENTS		BASE HOME DESCRIPTION FOR CENTRAL	
CLASSF	19.46	CLASS	3
		SQFT	1200
TYPE-A	0.00	GRADE	2
TYPE-B	-0.96	HEAT	1
NONE	-2.40	COOL	2
		AGE	20
RSF	1.20	PHYCON	2
EVAP	0.00	PATIO	32
NONE	-1.20	GARAGE	11
		POOL SF	0
PATIO	500	LAND FCV	3270
GARAGE	1500		
CARPORT	750	ADDS	2350
		SUBAREA	3
POOL PSF	10.00		
DEPR.ADJ	-0.16		
ADDS COEF	1.00		
CONSTANT	14543		
PHYSICAL DEPRECIATION :		3840	
BASE HOME VALUE:		36405	

SUBJECT PROPERTY VALUE		$	
		36405	
CLASS	4	8465	
SQFT	1450	4865	
GRADE	1		
HEAT	1	0	
COOL	1	2262	
AGE	15		
PHYCON	2		
PATIO	31	-350	
GARAGE	12	1500	
POOL SF	0	0	
LAND FCV	13787		
SUB ADJ	0	0	
AVG L FCV:	13787		IMPROVEMENT
BASEMENT :	0	0	SUBTOTAL
%,OBS,MOD:	0		0
SITUS ADJ:		0	
PHYS DEPR:	3480	360	
SUBJECT PROPERTY VALUE :		53507	

CLASS WEIGHTS		LM 1.00	R1 1.00	R2 1.00	R3 1.00	R4 1.00	R5 1.00	R6 1.00
CLZ-GRD		0.15	0.30	0.76	1.00	1.30	1.65	2.37
CLASSF	:	19.46						
DEPR.ADJ	:	-0.16						
ADDS COEF:		1.00						
BASEMENT	:	1.75	3.50	8.87	11.68	15.18	19.27	27.67
POOL		10.00	10.00	10.00	10.00	10.00	10.00	10.00
GRADE								
MINIMUM	:	-16.83	-14.21	-6.15	-1.95	3.31	9.44	22.05
FAIR	:	-16.54	-13.62	-4.67	0.00	5.84	12.65	26.66
GOOD	:	-16.25	-13.04	-3.19	1.95	8.37	15.86	31.27
HEATING								
TYPE-A	:	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TYPE-B	:	-0.14	-0.29	-0.73	-0.96	-1.25	-1.58	-2.28
NONE	:	-0.36	-0.72	-1.82	-2.40	-3.12	-3.96	-5.69
COOLING								
REF	:	0.18	0.36	0.91	1.20	1.56	1.98	2.84
EVAP	:	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WALL	:	-0.09	-0.18	-0.46	-0.60	-0.78	-0.99	-1.42
NONE	:	-0.18	-0.36	-0.91	-1.20	-1.56	-1.98	-2.84
PATIO/PORCHES								
1 SLAB		-600	-600	-600	-600	-600	-600	-600
2 SLABS		-425	-425	-425	-425	-425	-425	-425
3 SLABS		-250	-250	-250	-250	-250	-250	-250
4 SLABS		-75	-75	-75	-75	-75	-75	-75
1 COVERED		-350	-350	-350	-350	-350	-350	-350
2 COVERED		0	0	0	0	0	0	0
3 COVERED		350	350	350	350	350	350	350
4 COVERED		700	700	700	700	700	700	700
BOTH		-225	-225	-225	-225	-225	-225	-225
BOTH + 1		50	50	50	50	50	50	50
BOTH + 2		300	300	300	300	300	300	300
NONE		-850	-850	-850	-850	-850	-850	-850
GARAGES/ CARPORTS								
1 GARAGE		0	0	0	0	0	0	0
2 GARAGES		1500	1500	1500	1500	1500	1500	1500
3 GARAGES		3000	3000	3000	3000	3000	3000	3000
1 CARPORT		-750	-750	-750	-750	-750	-750	-750
2 CARPORTS		0	0	0	0	0	0	0
3 CARPORTS		750	750	750	750	750	750	750
BOTH		750	750	750	750	750	750	750
BOTH + 1		1500	1500	1500	1500	1500	1500	1500
NONE		-1500	-1500	-1500	-1500	-1500	-1500	-1500

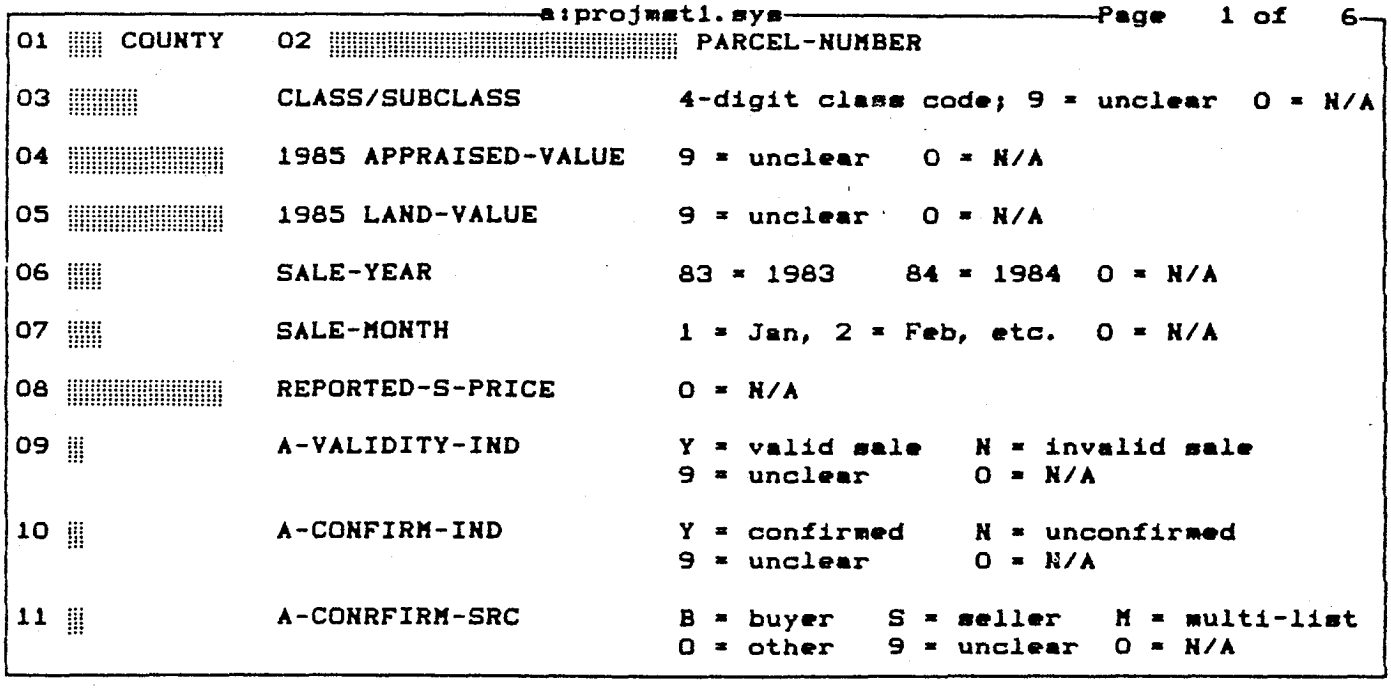
ure 5). To generate these reports (of which there were several hundred), the user needed only to enter the proper county and file name. The program then performed all the necessary sorting, calculating, and formatting, and printed the report.

Of particular interest in the study was appraisal performance for unsold parcels. MRA was used to develop valuation models from the unsold properties and was applied to the unsold parcels to obtain market-based appraisals. The appraisals were then used to generate appraisal ratio statistics for the unsold parcels in the same manner as sales were used to generate sales ratio statistics for the sold properties. Figure 6 shows an example of the output.

Conclusions

General purpose software opens a new, exciting world of power, flexibility, ease of updating, and independence to developers and users of computer-assisted appraisal systems. This paper briefly described two examples of what can be, and has been, accomplished.

Figure 4
Customized On-line Data Entry Screens



Create/Edit Form

Figure 4 (continued)

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a:projmst1.sys                                    Page   2 of   6
12       A-CONFIRM-METH     L = letter    P = phone       M = multi-list
                            F = field interview           O = other
                            9 = unclear                   0 = none

13       NEIGHBORHOOD       Assessor's neighborhood code (0 = none)

14       LAND-SIZE-IND      SF = sq ft    AC = acres    FF = front ft
                            BU = buildable units         9 = unclear
                            DU = density units           0 = N/A

15       LAND-SIZE          Number of sq ft, acres, etc. (enter
                            decimal for fractions, e.g., 2.75 acres)
                            99998 = unclear    0 = N/A

16       TOPOGRAPHY         1 = poor (severely sloped)   2 = standard
                            9 = unclear                  0 = N/A

17       VIEW               1 = poor (restricted)        2 = standard
                            3 = premium    9 = unclear   0 = N/A

18       TRAFFIC            1 = poor (heavy)   9 = unclear    0 = N/A
                            2 = standard (moderate or light)
```

Create/Edit Form

Figure 5
Single-Family Sales Ratio Statistics
for the County of Larimer

All Single-Family Properties

Category	Sales	Median	Mean	Aggregate mean	Coefficient of dispersion	Coefficient of variation	Price related differential	Standard error, mean
Single-family	616	1.009	1.007	1.007	9.9	12.9	100.0	.005

Single-Family Properties by Square Foot Range

Category	Sales	Median	Mean	Aggregate mean	Coefficient of dispersion	Coefficient of variation	Price related differential	Standard error, mean
800 square feet or less	21	.917	.886	.878	12.1	15.9	100.9	.031
801-1200 square feet	239	.976	.982	.977	10.5	13.4	100.6	.009
1201-1600 square feet	175	1.019	1.016	1.014	8.6	10.9	100.3	.008
1601-2400 square feet	158	1.040	1.047	1.041	8.8	11.4	100.5	.010
2401 square feet or more	23	.986	1.038	.998	14.1	17.1	104.0	.037

Single-Family Properties by Construction Quality

Category	Sales	Median	Mean	Aggregate mean	Coefficient of dispersion	Coefficient of variation	Price related differential	Standard error, mean
Below average	50	.935	.922	.911	12.3	15.9	101.3	.021
Average	477	1.007	1.008	1.004	9.5	12.4	100.3	.006
Above average	89	1.059	1.053	1.041	9.4	11.4	101.2	.013

Single-Family Properties by Year Built Range

Category	Sales	Median	Mean	Aggregate mean	Coefficient of dispersion	Coefficient of variation	Price related differential	Standard error, mean
Before 1945	56	.911	.923	.911	15.0	18.3	101.3	.023
1945-1959	46	.925	.957	.968	13.6	16.3	98.9	.023
1960-1974	140	1.004	1.016	1.017	10.6	13.5	99.9	.012
1975 or later	374	1.016	1.023	1.019	8.3	10.7	100.4	.006

Single-Family Properties by Sale Price Range

Category	Sales	Median	Mean	Aggregate mean	Coefficient of dispersion	Coefficient of variation	Price related differential	Standard error, mean
$24,999 or less	1	1.105	1.105	1.105			100.0	
$25,000-$49,999	54	.953	.988	.983	14.2	17.4	100.5	.023
$50,000-$74,999	327	1.001	.998	.998	9.2	11.9	100.0	.007
$75,000-$99,999	157	1.028	1.034	1.035	9.8	12.7	100.0	.010
$100,000-149,999	67	1.008	1.008	1.006	9.6	12.8	100.2	.016
$150,000 or more	10	.918	.964	.950	10.6	15.3	101.4	.047

Figure 6
Single-Family Ratio Statistics:
Unsold Properties for the County of Larimer

All Single-Family Properties

Category	Cases	Median	Mean	Aggregate mean	Coefficient of dispersion	Coefficient of variation	Price related differential	Standard error, mean
Total	471	1.009	1.019	1.032	9.3	12.3	98.7	.006

Single-Family Properties by Square Foot Range

Category	Cases	Median	Mean	Aggregate mean	Coefficient of dispersion	Coefficient of variation	Price related differential	Standard error, mean
800 square feet or less	15	.896	.913	.920	10.8	13.3	99.3	.031
801-1200 square feet	166	.970	.987	.992	9.3	12.4	99.5	.010
1201-1600 square feet	146	1.036	1.038	1.044	7.9	10.8	99.4	.009
1601-2400 square feet	122	1.025	1.040	1.043	8.1	11.0	99.7	.010
2401 square feet or more	22	1.075	1.084	1.095	13.0	17.7	98.9	.041

Single-Family Properties by Construction Quality

Category	Cases	Median	Mean	Aggregate mean	Coefficient of dispersion	Coefficient of variation	Price related differential	Standard error, mean
Below average	36	.849	.874	.876	9.2	11.0	99.8	.016
Average	354	1.014	1.022	1.026	8.2	10.8	99.6	.006
Above average	81	1.053	1.069	1.075	10.8	14.0	99.4	.017

Single-Family Properties by Year Built Range

Category	Cases	Median	Mean	Aggregate mean	Coefficient of dispersion	Coefficient of variation	Price related differential	Standard error, mean
Built before 1945	50	.931	.935	.953	11.9	14.9	98.1	.020
1945-1959	48	.999	1.000	1.001	10.4	12.8	99.9	.018
1960-1974	133	1.012	1.027	1.039	9.2	12.4	98.9	.011
1975 or later	240	1.022	1.035	1.045	8.3	11.0	99.1	.007

Single-Family Properties by Price Range

Category	Cases	Median	Mean	Aggregate mean	Coefficient of dispersion	Coefficient of variation	Price related differential	Standard error, mean
$25,000-$49,999	39	.912	.914	.918	11.7	14.3	99.6	.021
$50,000-74,999	217	.989	1.002	1.004	8.3	10.9	99.9	.007
$75,000-$99,999	142	1.034	1.043	1.044	7.8	10.9	99.9	.010
$100,000-$149,999	67	1.059	1.072	1.074	9.5	12.6	99.8	.016
$150,000 or more	6	1.140	1.126	1.121	13.5	21.3	100.5	.098

As with hard-coded systems, however, one should avoid the temptation to "reinvent the wheel." Systems development using general purpose software requires a substantial investment of time. Hence, developers and users should plan carefully, consult with colleagues who have undergone similar developments, and be prepared to undergo the necessary "learning curve." Nevertheless, general purpose software offers the possibility of achieving a highly customized, easily updated, state-of-the art system at low cost. For those attracted by such a challenge and the accompanying sense of professional accomplishment—go for it!

References

Fruitman, Cecilia M., and Alexander N. Chizewsky. 1987 (9-10 November). Arizona's transition to a mass appraisal and sales ratio system using generic software. Presented at the Conference on New Developments in Hardware and Software Options Available to Support Computer-Assisted Mass Appraisal. Cambridge, MA: International Association of Assessing Officers and Lincoln Institute of Land Policy.

Gloudemans, Robert J. 1981. Simplifying MRA-based appraisal models: The base home approach. *Assessors Journal* 16:155-166.

Gloudemans, Robert J. 1985. Base home methodology. In *Introduction to computer-assisted valuation*, ed. A. Woolery and S. Shea. Boston: Oelgeschlager, Gunn & Hain and Lincoln Institute of Land Policy.

Gloudemans, Robert J., and Garth Thimgan. 1987 (9-10 November). A statewide ratio study using microcomputers and generic software. Presented at the Conference on New Developments in Hardware and Software Options Available to Support Computer-Assisted Mass Appraisal. Cambridge, MA: International Association of Assessing Officers and Lincoln Institute of Land Policy.