

The Property Value Study Methods Used



Texas Property Tax

Susan Combs
Texas Comptroller of Public Accounts
May 2007



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This booklet presents an overview of the property value study and explains the study procedures in detail for those who want more in-depth knowledge.

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Definitions

Appraisal Ratio – The ratio of an individual property’s appraised value as shown on the appraisal roll to its market value.

Appraisal Roll Value – The property value estimated by the local appraisal district.

Coefficient of Dispersion (COD) – Measures how tightly or loosely the individual sample ratios cluster around the median. The lower the COD, the more ratios are found close to the median.

Confidence Interval – Measure of the reliability of the Comptroller’s estimate of school district value; expressed as a plus or minus margin of error range around the sum of Property Tax Division value estimates for tested categories.

Grace Period – A two-year period during which the local appraisal roll value is used to estimate the total taxable value for an eligible school district even though the local appraisal roll values are invalid.

Invalid Value – Local values outside the margin of error.

Local Value – The locally appraised value in a school district.

Margin of Error – An acceptable range of values within a school district or one-half of the confidence interval (expressed as a percentage).

Market Value – The price for which a property would sell under normal conditions. See Section 1.04(7), Tax Code, for the legal definition.

Median Level of Appraisal – A measure of accuracy of an appraisal district’s appraisals in relation to the standard of 100 percent of market value. The middle ratio in a list of appraisal ratios from a property category or appraisal district sorted by size (low ratio to high ratio or vice versa).

Outliers – Properties with abnormally high or low ratios that can distort ratio studies.

Property Tax Division (PTD) – The division of the Comptroller’s office responsible for conducting the Property Value Study.

Price-Related Differential (PRD) – Measure of inequity that may arise from systematic differences in the appraisal of low-value and high-value properties. Only an indicator—cannot alone prove vertical equity or inequity.

Sales Chasing – The practice of using the sale of a property to trigger a change in appraised value of that property to or near the property’s selling price.

State Value – The total taxable value in a school district as determined in the state’s Property Value Study.

Stratify – Placing similar properties into a group based on use or value.

Valid Value – Local values inside the margin of error.

Value-Stratified Weighted Mean Appraisal Ratio – A ratio mechanism to adjust the sample to be representative of the values in the property population from which it is taken. To calculate the value-stratified weighted mean appraisal ratio, the sample properties are grouped by value; a weighted mean is calculated for each value group; a market value is calculated for each value group; the market values are summed; and the total market value is divided into the total appraisal district value for the sample properties.

Weighted Mean Appraisal Ratio – Gives more weight to higher values of individual properties in a sample. Calculated by dividing the sum of the CAD appraisal roll values by the sum of the market values on properties in a sample.



Section One

The Property Value Study

This section presents an overview of the Property Value Study and then explains the study procedures in detail for those who want more in-depth knowledge of the process. References are made to provisions of the Tax Code, Government Code and Education Code. These laws collectively provide the basis for conducting the study, determining value and distributing of state funding to schools.

The Property Value Study – Overview

The Property Value Study is conducted annually by the Comptroller to estimate the taxable property value in each school district and to measure county appraisal district performance. It is often referred to as a ratio study, because it uses the appraisal roll value divided by its market value to calculate a ratio to measure effectiveness of the appraisal districts. The appraisal roll value is the property value estimated by the local appraisal district. The market value, in simple terms, is the price for which a property would sell under normal conditions.

Another component of the study is the Comptroller's annual appraisal district ratio analysis. This determines the level and uniformity of appraisals using data collected in the school district ratio study.

The primary purpose of the study is to help ensure that state funds for public schools are distributed equitably.

In Texas, public education is funded through a combination of state and local funds. Local funding comes from local property taxes. The chief appraiser of each county appraisal district (CAD) determines local property values and school districts set tax rates that determine the amount of local tax revenue. State funding is partly based on the total taxable property value within each school district as determined by the Property Value Study.

A school district's state funding is affected by the results of the study. School districts may use the study to monitor their appraisal district's performance. Consulting the study and working regularly with the appraisal district will help ensure that values are uniform and as close to market as possible.

The Commissioner of Education uses the study to ensure equitable distribution of education funds so that school districts have roughly the same number of dollars to spend per student, regardless of the school district's property wealth or lack of wealth. School districts with less taxable property value per student receive more state dollars for each pupil than districts with more value per student.

School Funding Equity Example

If the state were to rely solely on the values set by the 253 Texas appraisal districts, inequitable school funding could result for some school districts. For example, assume that two school districts, school district A and school district B, are identical in every respect except that the appraisal district for school district B does a better job of appraising property than the appraisal district for school district A. Appraisal districts are required to appraise most property at market value—in short, a property's fair selling price. If property values in school district A are at 75 percent of market value, while property values in school district B are at 100 percent of market value, school district A would appear to have less taxable property value per student than school district B. Accordingly, more state funding would flow to school district A, even though the two districts have the same number of students, the same taxable property value and are alike in every way. This is clearly an unfair result.

Court Challenges/State Response

A series of court cases brought in the 1980s by poor school districts challenged the Texas funding system. One of the issues was that property values were not set at uniform percentages of market value in each school district, resulting

in an unfair distribution of funds. As part of its response to these court challenges, the Legislature required an independent estimate of taxable property value in each school district to ensure fair school funding by providing more money to those districts that are less able to raise money locally because of insufficient taxable property wealth.

The independent estimate is accomplished through the study by adjusting school district property values to market value. If the locally appraised value in a school district (local value) is within an acceptable range of the adjusted value (state value), the Comptroller's Property Tax Division (PTD) certifies the local value to the Commissioner of Education. If the local value is outside the acceptable range, PTD certifies the state value, unless the school district is eligible for a grace period—a two-year period during which local value is used even though it is not at market value.

The state funds districts based on either the local value or the state value depending on which was certified. The state values do not directly affect local property taxes, which are based on the local appraised values provided by each appraisal district. If state value is used in the funding formula, however, it normally is higher than the local value and causes the school district to receive less money than expected.

Chapters 41 and 42 of the Education Code describe how the findings of the study are used in the school funding formula to determine state aid. For questions about state aid or the funding formula, contact the Texas Education Agency at (512) 463-9238.

Secondary Purpose

The secondary purpose of the study is to provide taxpayers, school districts, appraisal districts and the Legislature with measures of appraisal district performance. PTD staff achieves this by publishing measures of appraisal level and uniformity, and by conducting performance audits and appraisal standards reviews.

Appraisal Level and Uniformity

Section 5.10 of the Tax Code requires the Comptroller to measure appraisal district performance annually and to publish the results. PTD measures the level and uniformity of property tax appraisals in each appraisal district using data collected in the annual school district study. The level of appraisal shows whether the district has appraised typical properties at 100 percent of the legally required level—normally the market value. The uniformity of appraisal indicates

how much the percentage of market value varies from property to property.

Performance Audits

Section 5.12 of the Tax Code requires the Comptroller to conduct a performance audit in any appraisal district that fails to attain specified appraisal level and uniformity measures in the study. This section also requires the Comptroller, under certain circumstances, to perform an audit upon the written request of taxing units or taxpayers in the appraisal district. If an audit is done, the Comptroller's office will send a copy of the findings to the affected school districts so that they can work with their appraisal districts to remedy identified concerns.

Appraisal Standards Reviews

In addition to the performance audits, Section 5.102 of the Tax Code requires the Comptroller to perform an appraisal standards review of the appraisal district(s) serving a school district that receives a grace period. This review produces a report with recommendations for appraisal districts to improve their appraisal procedures so that their property will be appraised at market value. As with the performance audits, the affected school districts will receive a copy of the Comptroller's findings so that they can work directly with their appraisal district to remedy any problems.

The school district, through its appraisal district, can prevent any adverse funding consequences by achieving valid values in the year after the two-year grace period and can meet an important requirement for reestablishing eligibility for a future grace period by achieving valid values for two years in a row. If the appraisal district fails to take remedial action within a year of the report's issuance, the Comptroller is required to notify the judge of each district court in the county. The district judges then must appoint a five-member board of conservators to take control of the appraisal district. The board of conservators supervises the appraisal district until all its component school districts' values are found valid in the study.

Other Legal Requirements

Government Code Section 403.302 requires the Texas Comptroller to conduct the school district taxable value portion of the study.

Taxable Value

Taxable value is the estimated property wealth of each school district. By law, it equals the market value of all property

in a district minus certain exemptions and deductions. The Comptroller’s estimated taxable value reflects deductions for state-mandated homestead, disabled veterans’ exemptions and value limitations. Deductions are also made for reinvestment zones, freeport exemptions, productivity appraisal of qualified agricultural lands, the school tax ceiling for homeowners age 65 and older or disabled and other state-mandated exemptions.

In estimating school district taxable values, the Government Code requires the Comptroller to:

- use generally accepted sampling, valuation and statistical techniques;
- ensure that different levels of appraisal on sold and unsold property do not adversely affect the accuracy of the study; and
- test the validity of taxable values and presume that appraisal roll values are correct when values are valid.

Margin of Error

The Comptroller tests the validity of the taxable values assigned to each category of property by the appraisal district by constructing a statistical margin of error around the Comptroller’s estimate of value for selected property categories in each school district. Values are assumed *valid*, or acceptable, when they are within the error margin. The margin of error is plus or minus 5 percent of the state value at a minimum, but may be higher. Values outside this margin of error are considered *invalid*.

Local Value Above Market Value

Even though a school district’s local value is invalid, the law requires the Comptroller to certify the local value if it is higher than the state value. This requirement prevents a school district from receiving extra state funding based on a lower state value, while receiving local funds from taxes on property appraised above market value.

Grace Period

The Government Code also requires the Comptroller to use the local appraisal roll values to estimate the total taxable

value in an eligible school district for up to two years even when the local appraisal roll values are invalid. This is known as a grace period. A school district is eligible for the grace period if it meets three conditions:

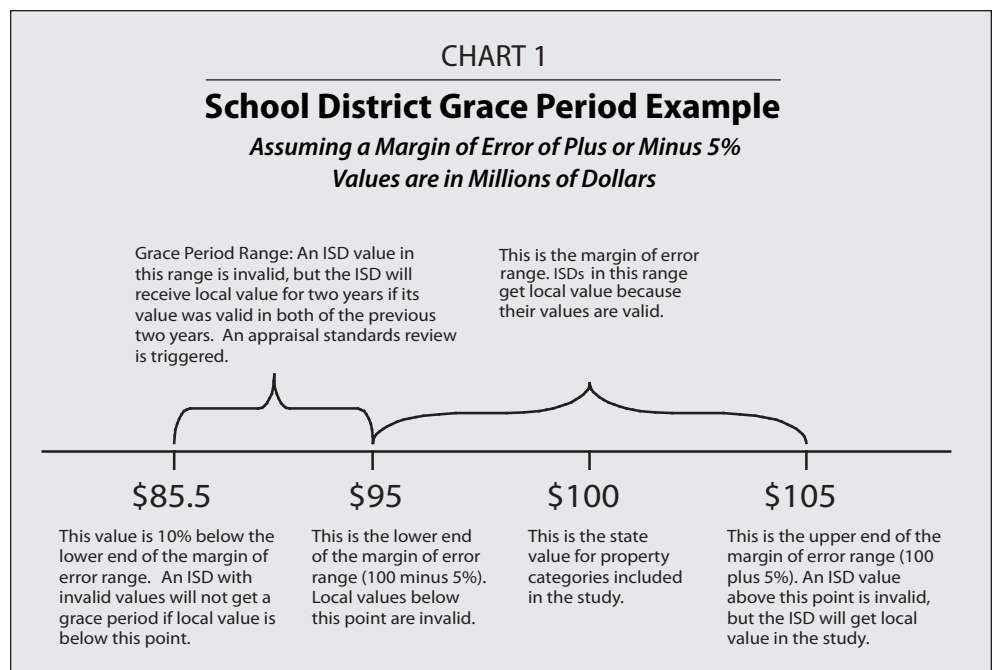
- the district’s values are invalid in the most recent Property Value Study;
- the district’s values were valid in the two studies preceding the most recent study; and
- the district’s local test value is above 90 percent of the lower threshold of the margin of error.

Chart 1 illustrates how a school district could be eligible for a grace period if its values are invalid.

Study Timeline

The study is an annual project conducted by PTD staff with the assistance of appraisal districts and taxpayers. The study begins in February each year and concludes in July of the following year. A new study begins while the previous year’s study is being modified by protests, so there is considerable overlap.

Under the Government Code, the agency must certify the preliminary findings of taxable value for each district before February 1 of the year following the year under study. The agency delivers its findings to school and appraisal districts and also certifies them to the Commissioner of Education. Districts that wish to protest preliminary value findings must do so within 40 days after the date of amended preliminary certification or certification of preliminary findings.



The Comptroller publishes the results of the appraisal district study simultaneously with the school district study and distributes copies to all appraisal districts. Although the Tax Code does not give appraisal districts the right to protest study findings, the Comptroller allows appeals of level and uniformity measures in an effort to enhance fairness and accuracy.

After study protests are complete on or about July 1, the Comptroller certifies final values to the Commissioner of Education, who uses them to adjust school district funding the following September.

The Property Value Study – Detailed Procedures

This section lists the property categories used in the study, gives an overview of school district taxable value calculation and describes the procedures and calculations used in the study. It then describes procedures specific to each property category.

Property Categories

The Government Code and Tax Code require the Comptroller to develop ratios and value estimates for property categories and to combine information on the various property categories into overall estimates.

The property categories generally used are:

- A. real property: single-family, residential;
- B. real property: multifamily, residential;
- C. real property: vacant lots and tracts;
- D/E. real property: acreage at market value and farm and ranch improvements;
- DI. real property: acreage at productivity value;
- F1. real property: commercial;
- G. real property: oil, gas and other minerals;
- J. real and tangible personal property: utilities; and
- L1. personal property: commercial.

The Comptroller may group properties into any other category or subcategory necessary for the efficient and accurate completion of the study. Pages 13-15 provide more information about these categories

Calculating Taxable Value – Overview

The PTD calculates the total taxable value in a school district, referred to as *state value*, by estimating market value or by accepting the local appraised value in each property

Step-by-Step Study Summary

Page:

Step 1. – Gather and Prepare Market Data 5

The first step in the PVS is to gather and prepare market data, including information on property sales, building costs and income information. If enough recent sales information is available, these data will become the basis of the PVS.

Step 2. – Select a Sample. 5

The second step is to select a sample. Headquarters staff assigns sample sizes for each property category in each school district based on a statistical model. The statistical model is designed to achieve a uniform 5 percent margin of error in each school district to the extent practicable.

Step 3. – Appraise Property 5

PTD appraises sample properties to achieve the required sample size when insufficient sales are available.

Step 4. – Match PTD Values with Local Values. 5

PTD staff must match each sample property with the corresponding CAD records and obtain several items from the records.

Step 5. – Compute Property Ratios. 5

Step five is to compute individual property appraisal ratios. An appraisal ratio for an individual property is the ratio of the property’s appraised value as shown on the appraisal roll to its market value.

Step 6. – Stratify 6

The next step is to stratify, or group properties by common features. Stratifying properties so that similar kinds of property are in each group before calculating PVS statistics makes the results more meaningful and accurate.

Step 7. – Statistical Analysis. 7

The next step is to compute several statistics that will enable PTD to adjust reported school district values to market value, and that will provide a means to interpret the PVS results.

Step 8. – Use the Results 13

The Texas Education Agency uses the Texas PVS results to equalize school funding. Property owners use the PVS to evaluate whether they are being taxed fairly. Appraisal districts use the PVS to evaluate their performance and to determine the need for reappraisal.

category in the district and then adding these category values for an overall school district value. (See pages 2 and 3 for more information.)

To estimate most category values, PTD obtains a representative sample of properties in each category, computes a weighted mean ratio from this sample and divides this ratio into the school district's self-reported appraisal roll value for the category.

There are several property categories for which the Comptroller does not develop ratios or value estimates. These categories are included in the study at the local appraised value reported by the district.

Step 1. — Gather and Prepare Market Data

PTD gathers and prepares market data, including property sales, building costs and income information. If enough recent sales information is available, these data will become the basis of the study. PTD staff gathers sales information from any available source, including CADs, multiple listing services, realtors, appraisers, title companies and taxpayers. The sales prices must be verified, edited and adjusted as necessary for financing, personal property and time of sale. Building costs and income information become important when sales are scarce, because in this situation, PTD must appraise sample property to meet sample size requirements. The appraisals may be based on comparable sales information, building costs, market rents and vacancy rates or other market information.

Step 2. — Select a Sample

PTD supervisory staff assigns sample sizes for each property category included in the study in each school district based on a statistical model designed to achieve a uniform 5 percent margin of error to the extent practicable. The sample includes a census of all recent sales when the number of sales is smaller than, or does not greatly exceed, the target sample size. If the number of available sales greatly exceeds the required sample size, the sample is randomly selected from the sales population. If there are not enough sales to achieve the assigned sample size, PTD randomly selects enough properties to fill the gap and appraises them. In any case, supervisors are responsible for adjusting sample sizes to match available staff resources.

PTD does not sample industrial property because of the lack of publicly available appraisal information and the cost of performing appraisals of this kind of property. If a property

category is appraised at less than \$250 million and includes less than 5 percent of the value in a school district (excluding industrial property), PTD generally does not include that category in the study.

PTD's samples of properties may sometimes include outliers, properties with abnormally high or low ratios. If PTD determines that an outlier is the result of an appraisal district error or unusual market variability, it remains in the study. If the outlier was caused by a clerical error, a property mismatch or an error in appraisal judgment, PTD attempts to correct the error so that the property can remain in the study. If the staff finds that the outlier is a non-market transaction, the staff excludes the outlier from the sample. To improve sample representativeness, PTD may exclude extreme outliers that remain after the process described above is concluded.

See **Appendix A** for a discussion of the modified sampling procedures used when sales chasing is suspected.

Step 3. — Appraise Property

PTD appraises sample properties to achieve the required sample size when insufficient sales are available. After randomly selecting property for appraisal, PTD physically inspects each property. A CAD staff member may assist with routing these inspections. If physical inspection of an unimproved property (no buildings) is impossible or unnecessary, PTD may use appraisal cards, aerial photographs, soil maps and other relevant information to perform the appraisal.

For each property, PTD records the property class, construction type, condition, age, amenities and any outbuildings or other additions such as pools. Staff notes property specifics such as neighborhood influences, restrictions, etc., and checks to determine that the square footage recorded by the CAD is reasonable. If the CAD record is incorrect, staff measures the property to obtain an accurate square footage.

Appraisals must reflect a property's market value as of January 1 of the study year. PTD appraisers use the Comptroller's procedures in conjunction with the Comptroller's computerized Field Appraiser System to classify and appraise residential and commercial sample property unless better information is available or unless that kind of property is not included in the procedures or the Field Appraiser System. PTD uses other specialized computer software to appraise oil and gas reserves and other complex property types and develops separate appraisal schedules for vacant land.

Along with properties entered in the sample as appraisals, PTD also selects and appraises sold properties to develop a local modifier. A local modifier adjusts the PTD appraisal system values to account for differences in local markets.

Step 4. — Match PTD Values with Local Values

PTD staff matches each sample property with the corresponding CAD records and obtains several items from the CAD records. These include the CAD and ISD identification codes, the category code, the account number, the legal description, the parcel address, the sale/appraisal code, the sale date, the sale price, the source code, the CAD improvement value, the CAD land value, the furniture, fixtures and equipment value and the inventory value, if applicable to the sample property.

A proper match between the sample property and the CAD property records is important to ensure that the comparison of PTD’s value and the CAD’s value for the sample property results in a meaningful ratio.

Step 5. — Compute Property Ratios

An appraisal ratio for an individual property is the ratio of the property’s appraised value as shown on the appraisal roll to its market value. The market value is indicated by the sales price or PTD appraised value. **Table 1** shows appraisal ratios for a sample consisting of both sales and appraisals as indicators of market value. For example, Sale Number 1 in Table 1 has an appraisal roll value of \$65,834 and an adjusted sale price of \$83,113. Dividing \$65,834 by \$83,113 yields an appraisal ratio of 0.79 for this parcel. No judgment about appraisal district performance should be made on the basis of a

TABLE 1			
Sample Calculation of Weighted Mean Appraisal Ratio			
School District ABC			
Category A: Single-family Residential			
SALES			
Sale Number	Appraisal Roll Value	Adjusted Sale Price	Individual Appraisal Ratio
1	\$ 65,834	\$ 83,113	0.79
2	75,254	90,720	0.83
3	94,420	135,610	0.70
4	99,880	113,310	0.88
5	82,253	109,250	0.75
6	89,654	94,715	0.95
7	76,502	91,680	0.83
8	111,020	128,048	0.87
9	44,441	62,370	0.71
10	64,519	75,905	0.85
11	64,842	81,127	0.80
12	39,479	41,925	0.94
13	193,344	245,700	0.79
14	98,885	127,493	0.78
15	114,788	118,898	0.97
16	92,088	113,645	0.81
17	84,449	84,995	0.99
18	21,090	25,988	0.81
19	22,080	27,398	0.81
APPRAISALS			
Appraisal Number	Appraisal Roll Value	Appraisal Value for Study	Individual Appraisal Ratio
1	\$ 97,576	\$ 110,741	0.88
2	60,437	70,964	0.85
3	107,543	148,828	0.72
4	60,264	86,303	0.70
5	69,708	76,117	0.92
6	76,935	98,327	0.78
TOTAL SALES AND APPRAISALS			
Total Appraisal Roll Value for Test	Total Value of Sales and Appraisals	Weighted Mean Appraisal Ratio	
\$2,007,285	÷	\$ 2,443,170	= .8216
Total Appraisal Roll Category Value	Weighted Mean Appraisal Ratio	Estimated Category Market Value	
\$27,621,400	÷	.8216	= \$33,619,036

single property ratio. Statistics based on aggregated ratios are intended for performance measurement.

Step 6. — Stratify

Stratifying properties so that similar kinds of property are in each group before calculating study statistics makes the results more meaningful and accurate. A sample is selected for each property category or other stratum included in the study. At this point PTD has already stratified properties by their use—single-family residential properties are grouped together, for instance.

In addition to categorizing property by its use, PTD uses a further level of stratification—that is, value stratification. Value stratification is used only in the school district study, not in the appraisal district study. PTD obtains the information needed to value-stratify appraisal roll values from previous stratification surveys or the appraisal rolls, depending upon availability. In a few school districts, value stratification information is not available.

PTD has established a value-stratification procedure that results in as many as six strata. For the most part, the value ranges within the strata vary from school district to school district, and from year to year depending entirely on the distribution of property value within each school district.

The six value strata are:

Stratum #1 – The low-value stratum. After sorting all the properties in the category from lowest value to highest value, and beginning with the lowest-valued property, this stratum contains the low-valued properties that collectively equal 5 percent of the category’s total appraised value. PTD does not study this stratum. Instead, PTD accepts the locally determined value.

Stratum #2 – This stratum contains all properties that individually exceed 20 percent of the value in the property category. PTD may or may not study these high-valued properties.

Stratum #3 – After the remaining properties are sorted from lowest value to highest value, properties representing about the first 25 percent of the remaining appraisal roll value in the category comprise stratum 3.

Stratum #4 – Properties representing about the second 25 percent of the remaining appraisal roll value in the category comprise stratum 4.

Stratum #5 – Properties representing about the third 25 percent of the remaining appraisal roll value in the category comprise stratum 5.

Stratum #6 – Properties representing about the fourth 25 percent of the remaining appraisal roll value in the category comprise stratum 6.

PTD generally studies strata 3-6 using random sampling procedures.

In some school districts, the staff finds certain properties in a category sample sufficiently different from the remaining sample properties to warrant treatment as “exception” properties. An exception property is a property placed in its own separate stratum. The rationale is to offset the potential bias that an exception property might have on the estimated ratio. PTD uses other stratification methods in special circumstances, such as the resolution of a protest, when the evidence shows that some property characteristic other than use or value is distorting the appraisal level.

Step 7. — Statistical Analysis

The next step is to compute several statistics that will enable PTD to adjust reported school district values to market value, and that will provide a means to interpret the study results. These statistical computations will be shown below in two sections. The first explains statistics computed for the school district study required by Section 403.302 of the Government Code, while the second explains statistics computed for the appraisal district study required by Section 5.10 of the Tax Code.

PTD uses different statistical measures for school districts and appraisal districts.

School District Statistics

The statistics used in the school district study are the weighted mean ratio, the stratified weighted mean ratio and the margin of error.

Weighted mean – Table 1 shows the computation of a weighted mean appraisal ratio. This ratio takes into account the different values of the individual properties making up the sample by giving more weight to higher values. It is calculated by totaling the appraisal roll values, totaling the sales prices and staff appraisals and dividing the first sum by the second. As shown in Table 1, the total appraisal roll value for this sample is \$2,007,285 and the total value of sales and appraisals is \$2,443,170. Dividing the former by the latter produces the weighted mean appraisal ratio of 0.8216. Finally, dividing the district’s total self-reported appraisal roll category value of \$27,621,400 by the weighted mean appraisal ratio

TABLE 2

Sample Calculation of a Value-Stratified Weighted Mean Appraisal Ratio

(Step 1)

	Appraisal Roll Value <i>in the sample</i>		Appraisal/ Sale Price <i>in the sample</i>	=	Ratio* CAD/PTD <i>in the sample</i>
STRATUM 1: \$-0- to \$2,500					
Stratum 1 Total:	not sampled		not sampled		
STRATUM 2: \$1,205,000 and up					
	1,205,000	÷	1,209,961	=	0.9959
Stratum 2 Total:	1,205,000	÷	1,209,961	=	0.9959
STRATUM 3: \$2,501 to \$15,300					
	11,243	÷	8,000	=	1.4054
	13,510	÷	10,000	=	1.3510
	14,194	÷	11,500	=	1.2343
	14,800	÷	12,000	=	1.2333
	15,001	÷	13,000	=	1.1539
Stratum 3 Total:	68,748	÷	54,500	=	1.2614
STRATUM 4: \$15,301 to \$47,573					
	20,374	÷	20,000	=	1.0187
	20,477	÷	20,000	=	1.0238
	20,994	÷	20,000	=	1.0497
	25,806	÷	24,800	=	1.0405
	28,166	÷	27,000	=	1.0432
Stratum 4 Total:	115,816	÷	111,800	=	1.0359
STRATUM 5: \$47,574 to \$110,625					
	51,007	÷	52,000	=	0.9809
	52,191	÷	52,000	=	1.0037
	53,217	÷	54,000	=	0.9855
	54,141	÷	54,000	=	1.0026
	57,396	÷	57,000	=	1.0070
Stratum 5 Total:	267,952	÷	269,000	=	0.9961
STRATUM 6: \$110,626 to \$465,581					
	111,648	÷	125,000	=	0.8932
	114,140	÷	135,000	=	0.8455
	139,498	÷	150,000	=	0.9300
Stratum 6 Total:	365,286	÷	410,000	=	0.8909
Grand Totals:	<u>\$2,022,802</u>		<u>\$2,055,261</u>		
<i>totals based on 19 parcels</i>					
Mean Ratio	<i>(unweighted average)</i>				1.0631
	<i>average based on 19 parcels</i>				
Weighted Mean Ratio					0.9842
	<i>\$2,022,802/\$2,055,261</i>				
Price-Related Differential					1.0802
	<i>mean ratio 1.0631/weighted mean ratio 0.9842</i>				

*Rounded to four places.

of 0.8216 produces an estimated category market value of \$33,619,036. This result shows below-market appraisal, and could reduce the school district's funding.

Stratified weighted mean – A stratified weighted mean appraisal ratio is an overall property category ratio calculated by combining the weighted mean ratios of various sub-categories or strata. As discussed above, PTD uses property use and property value to define each stratum. PTD uses these value-stratified weighted mean appraisal ratios whenever feasible to estimate market values for residential properties (Categories A and B), vacant lots (Category C), commercial properties (Categories F1 and L1) and minerals (Category G). PTD stratifies these ratios by value stratum within each category if reasonably accurate stratification data are available.

A value-stratified weighted mean appraisal ratio is a mechanism used to automatically adjust the sample to be representative of the property population from which it is taken. For example, low-valued properties tend to be clustered in certain geographic areas, while mid-range and high-valued properties tend to be clustered in others. Similarly, construction types tend to vary with value. A value-stratified weighted mean appraisal ratio adjusts for location effect and for the effects of varying construction types. In addition, it is a particularly useful tool for enhancing sample representativeness when appraisal levels in a category vary significantly between lower-valued and higher-valued properties.

Tables 2, 3 and 4 show how a stratified weighted mean appraisal ratio is calculated and how it differs from a weighted mean and a simple mean appraisal ratio. The stratified weighted mean appraisal ratio for a category is calculated by:

- grouping sample properties by appraisal roll value stratum;
- calculating a weighted mean appraisal ratio for each value stratum;
- dividing the weighted mean appraisal ratio into the CAD total appraisal roll value for each value stratum to estimate a market value;
- adding these individual market value stratum estimates; and
- dividing the sum of the CAD values in each stratum by the sum of PTD's individual market value stratum estimates.

TABLE 3

**Sample Calculation of a Value-Stratified
Weighted Mean Appraisal Ratio
(Step 2)**

Stratum Number	Number of Parcels in the Sample	CAD Value in the Sample	÷	PTD Estimate in the Sample	=	Stratum Ratio Weighted Mean in the Sample*
(#)	(n _{sample})	(TX _{sample})		(TY _{sample})		(r1 _{sample})
1	n/a	n/a		n/a	=	1.0000
2	1	1,205,000	÷	1,209,961	=	census
3	5	68,748	÷	54,500	=	1.2614
4	5	115,816	÷	111,800	=	1.0359
5	5	267,952	÷	269,000	=	0.9961
6	3	365,286	÷	410,000	=	0.8909

*Rounded to four places.

Table 2 lists the properties in a hypothetical random sample. The sample properties are grouped in six strata. A ratio is calculated for each property, by dividing the CAD value by the PTD appraisal value or sale price. A weighted mean ratio is calculated for each stratum by dividing the sum of the CAD values by the sum of the PTD appraisal or sale amounts. A weighted mean ratio is calculated for the entire property category by dividing the sum of the CAD values in every strata by the sum of the PTD values in every strata. A simple mean ratio is calculated by summing all the individual property ratios in the entire category and dividing by the number of ratios. The weighted mean and simple mean are calculated for comparison to the stratified weighted mean in **Table 4** and for use in calculating the price-related differential (PRD). The PRD is calculated by dividing the simple mean by the weighted mean. See an explanation of the PRD under *Appraisal District Statistics* below.

Table 3 lists the strata shown in **Table 2** and shows the number of sample parcels, the CAD value of the sample properties, the PTD value of the sample properties and the weighted mean ratio for each stratum. **Table 3** also shows how the weighted mean stratum ratios are calculated by dividing the CAD value in each stratum by the PTD value in each stratum.

Table 4 lists the strata shown in **Table 2** and **Table 3** and shows the number of parcels in the stratum, the CAD value in the stratum, the stratum ratio (from **Table 2** or **Table 3**)

and the PTD market value estimate for each stratum. **Table 4** also shows the calculation of the stratified weighted mean ratio by dividing the sum of the CAD values for each stratum by the sum of the PTD market value estimated for each stratum. This stratified weighted mean ratio is divided into the appropriate self-reported category total to develop the PTD's market value estimate for the category. Refer to the *ISD Summary Worksheet* to see this final calculation.

There are substantial differences in the level of appraisal among value strata in **Table 2**. Lower-valued properties are appraised at higher levels than higher-valued properties, as indicated by a price-related differential well above 1.03. Using a stratified weighted mean appraisal ratio will adjust for these differences so that they will not bias the sample ratio and the resulting market value estimate for the category.

If stratification data are not available for a school district, stratified weighted mean appraisal ratios cannot be calculated. If the data to calculate a value-stratified ratio become available at any time during the process, including the protest process, PTD may calculate a value-stratified ratio.

Margin of error – The margin of error is equal to one half of the confidence interval expressed as a percent of total value studied in a school district. The confidence interval is a computed range of school district values for which the Property Value Study has not proven that the state's estimate of value is significantly different from the local value. If the school dis-

TABLE 4
Sample Calculation of a Value-Stratified Weighted Mean Appraisal Ratio
(Steps 3-5)

Stratum Number	Number of Parcels in the Stratum	CAD Value in the Stratum	÷	<u>Stratum Ratio</u> Weighted Mean Ratio in the Sample	=	PTD Estimate in the Stratum**
(#)	(N _{Stratum})	(TX _{Stratum})		(r1 _{sample})		(TY _{Stratum})
1	711	300,224	÷	1.0000	=	\$ 300,224
2	1	1,205,000	÷	census	=	1,209,961
3	259	1,495,515	÷	1.2614	=	1,185,570
4	56	1,463,787	÷	1.0359	=	1,413,029
5	22	1,500,526	÷	0.9961	=	1,506,395
6	7	1,544,658	÷	0.8909	=	1,733,737
	+	+				+
	=	=				=
	1,056	7,509,710		1.0219		\$7,348,916
	Total Stratum Parcels	Total CAD Value		(7,509,710 ÷ 7,348,916) Stratified Ratio		Total PTD Estimate

**Rounded to the nearest dollar.

trict’s local value is outside the range, the study has proven, statistically at least, that the school district’s value is incorrect because it is significantly different from the state’s estimate.

For example, assume that PTD staff estimates market value in sampled property categories in school district ABC to be \$100 million before exemptions. The margin of error is computed to be plus or minus 5 percent of \$100 million. Market value plus 5 percent is \$105 million; market value minus 5 percent is \$95 million. The \$100 million estimate is known as a *point estimate*; the confidence interval of \$95 million to \$105 million is often called an *interval estimate*. The PTD uses the margin of error to determine whether local value is valid. If the school district’s value is inside the margin of error range, it is accepted as valid. If not, it is considered invalid.

The Legislature has instructed the Comptroller’s office to include enough samples to obtain a margin of error that does not exceed 5 percent, if resources permit. PTD, to make the study more uniform, has set a 5 percent floor on the margin of error. This means that if the statistically calculated margin of error is less than 5 percent it is set at 5 percent. On the other hand, if PTD’s margin of error is more than 5 percent,

PTD will use the higher margin of error to decide whether the local value is valid.

More detailed explanations of the confidence interval and margin of error computations can be found in **Appendix B** and **Appendix C**.

Appraisal District Statistics

For the appraisal district study, PTD aggregates samples collected for the school district study to the appraisal district level. PTD then calculates statistical measures of appraisal level and uniformity in each property category and for the CAD overall. The measure of appraisal level is the median. The measures of appraisal uniformity include the coefficient of dispersion (COD), the percentage of properties within 10 and 25 percent of the median and the price-related differential (PRD). Together, the median level of appraisal, the COD, the percentage of properties within 10 or 25 percent of the median and the PRD enable the Property Value Study to address the legal requirements that appraisals be equal, uniform and at 100 percent of market value.

Samples from each category are aggregated to the appraisal district level, with one exception. The ratio derived for

agricultural acreage receiving productivity appraisal is not a median derived from a property sample. Consequently, PTD does not calculate measures of appraisal uniformity for acreage receiving productivity appraisal. The appraisal district performance measures listed under “D. Rural Real-Market Value” on the appraisal district summary worksheet are derived from the property samples used to compute the weighted mean appraisal ratios for estimating the market values of non-qualified acreage and farm and ranch improvements.

Median – The median level of appraisal measures the accuracy of an appraisal district’s appraisals in relation to the standard of 100 percent of market value. The International Association of Assessing Officers (IAAO) *1999 Standard on Ratio Studies* sets the standard for appraisal level at 95 – 105 percent of market value when the study results are used for funding equalization programs, and at 90 – 110 percent of market value when the results are used for other purposes.

Section 1.12(c) of the Tax Code defines the median appraisal ratio as:

The median appraisal ratio for a sample of properties is, in a numerically ordered list of the appraisal ratios for the properties: (1) if the sample contains an odd number of properties, the appraisal ratio above and below which there is an equal number of appraisal ratios in the list; or (2) if the sample contains an even number of properties, the average of the two consecutive appraisal ratios above and below which there is an equal number of appraisal ratios in the list.

The value of individual properties does not influence the median ratio; only the ranking of individual ratios within the sample matters. The median ratio falls at the middle of a group of ratios ranked from highest to lowest or lowest to highest.

Table 5 uses 19 sales (marked “S1” to “S19”) and six appraisals (marked “A1” to “A6”) to show how to identify the median ratio. In this table, the appraisal ratios are ranked from the highest ratio to the lowest. Twenty-five properties make up the sample. The median ratio, 0.81, is 13th on the list. Twelve properties are ranked above it, and 12 are ranked below it.

An easy way to find the median for a sample containing an odd number of properties is to divide the total count by two, then round the result upward to the nearest whole number.

The sample shown in **Table 5** contains 25 parcels. Dividing 25 by two yields 12.5. Rounding upward to the nearest whole number produces 13. The 13th ratio is the median.

For an even-numbered sample, the median is the average of the two middle ratios. If there were 24 properties in the sample, the median would be the average of ratios 12 and 13. Eleven ratios would be above 12 and below 13.

TABLE 5

Sample Calculation of Median Appraisal Ratio
XYZ County Appraisal District
Category A: Single-family Residential

Sales and Appraisals			
Sale or Appraisal Number	Appraisal Roll Value	Adjusted Sale Price or Appraised Value	Individual Appraisal Ratio
S 17	\$ 84,449	\$ 84,995	0.99
S 15	114,788	118,898	0.97
S 6	89,654	94,715	0.95
S 12	39,479	41,925	0.94
A 5	69,708	76,117	0.92
S 4	99,880	113,310	0.88
A 1	97,576	110,741	0.88
S 8	111,020	128,048	0.87
S 10	64,519	75,905	0.85
A 2	60,437	70,964	0.85
S 2	75,254	90,720	0.83
S 7	76,502	91,680	0.83
S 16	92,088	113,645	0.81*
S 18	21,090	25,988	0.81
S 19	22,080	27,398	0.81
S 11	64,842	81,127	0.80
S 1	65,834	83,113	0.79
S 13	193,344	245,700	0.79
S 14	98,885	127,493	0.78
A 6	76,935	98,327	0.78
S 5	82,253	109,250	0.75
A 3	107,543	148,828	0.72
S 9	44,441	62,370	0.71
S 3	94,420	135,610	0.70
A 4	60,264	86,303	0.70
Total = 25			
* 0.81 = Median Appraisal Ratio for Category A, XYZ Appraisal District.			

PTD calculates a median appraisal level for each major category of property in each appraisal district, provided there are at least five properties in the sample. PTD then combines the properties making up the sample for each category into a larger sample of all properties in the appraisal district. The median ratio from the larger sample is listed as the overall ratio for the appraisal district.

Coefficient of dispersion – The COD measures how tightly or loosely the individual sample ratios are clustered around the median. The code requires the agency to calculate a coefficient of dispersion around the median for each major property category. The COD is one measure of appraisal uniformity.

Technically, the COD expresses as a percentage of the median the average absolute deviation of the appraisal ratios in a sample from the sample’s median. A high COD indicates high variation—few ratios close to the median and low appraisal uniformity. A low COD indicates low variation—ratios clustered tightly around the median and high appraisal uniformity.

The IAAO’s *1999 Standard on Ratio Studies* contains standards for CODs. These are:

1. single-family residential and condominiums—15 or less; in areas of newer or fairly similar residences—10 or less; heterogeneous rural residences and seasonal homes—20 or less;
2. vacant land: 20 or less;
3. income properties in large, urban jurisdictions: 15 or less; and
4. income properties in other jurisdictions: 20 or less.

The IAAO does not publish standards for other real and personal property, but notes that they vary with local conditions.

The COD measures appraisal uniformity independently of the median level of appraisal. As a result, CODs allow comparison of appraisal uniformity among districts or property categories where median levels of appraisal differ significantly.

Calculating a COD requires six steps:

1. subtract the median ratio for the sample from each individual ratio making up the sample. The result is the deviation for each ratio;
2. convert each deviation to its absolute value;
3. total the absolute values of each deviation;

TABLE 6
Sample Calculation for Coefficient of Dispersion
County Appraisal District
Category A: Single-family Residential

Sale or Appraisal Number	Individual Property Ratio %	Difference from Median (81%)	Absolute Value of Difference
S 17	99	+ 18	18
S 15	97	+ 16	16
S 6	95	+ 14	14
S 12	94	+ 13	13
A 5	92	+ 11	11
S 4	88	+ 7	7
A 1	88	+ 7	7
S 8	87	+ 6	6
S 10	85	+ 4	4
A 2	85	+ 4	4
S 2	83	+ 2	2
S 7	83	+ 2	2
S 16	81	0	0
S 18	81	0	0
S 19	81	0	0
S 11	80	- 1	1
S 1	79	- 2	2
S 13	79	- 2	2
S 14	78	- 3	3
A 6	78	- 3	3
S 5	75	- 6	6
A 3	72	- 9	9
S 9	71	- 10	10
S 3	70	- 11	11
A 4	70	- 11	11

TOTAL OF ABSOLUTE VALUES = 162

162.00	– Total of Absolute Values
÷	25.00
=	6.48
	– Average Absolute Deviation
÷	81.00
=	.08
	– Median Appraisal Ratio
x	100.00
=	8.00
	– Coefficient of Dispersion

4. divide the total deviation by the number of properties in the sample to get the average absolute deviation;
5. divide the average absolute deviation by the median ratio; and
6. multiply the result by 100.

Table 6 shows a sample calculation of a COD.

PTD calculates a COD for each major category of property in an appraisal district if the sample has at least five properties and combines the samples for each category into a larger sample to calculate the overall COD.

Percentage of properties within 10 percent and 25 percent of the median – To calculate the first of these, multiply the median appraisal ratio by 10 percent. Adding this result to the median yields the ratio that exceeds the median by 10 percent. Subtracting the result from the median yields the ratio 10 percent below the median. Count the number of properties in the sample that have ratios equal to or between these two numbers. Dividing that count by the total number of properties shows the percentage within 10 percent of the median.

To calculate the percentage within 25 percent of the median, multiply the median times 25 percent and then add and subtract the result to find the upper and lower end of the range. The percentages are computed if the sample contains at least six properties.

The COD and the percentage of properties within 10 percent and 25 percent of the median are measures of “horizontal” ratio dispersion. They measure how consistently appraisal districts appraise properties at the same level (percentage of market value) without regard to the value of the properties. A low COD and high percentages indicate equitable appraisals, while a high COD and low percentages indicate inequitable appraisal.

In Table 6, the properties in the sample that have ratios between 89.1 percent and 72.9 percent are within 10 percent of the median, while properties that have ratios between 101.2 percent and 60.7 percent are within 25 percent of the median. In Table 6, all properties fall within 25 percent of the median.

Price-related differential – The PRD measures another form of inequity that may arise from systematic differences in the appraisal of low-value and high-value properties. According to the IAAO 1999 *Standard on Ratio Studies*,

TABLE 7
Sample Calculation of Price-Related Differential
XYZ County Appraisal District
Category A. Single-family Residential

Sales and Appraisals						
Sale or Appraisal Number	Appraisal Roll Value	Adjusted Sale Price or Appraised Value	Individual Appraisal Ratio			
S 17	\$ 84,449	\$ 84,995	0.99			
S 15	114,788	118,898	0.97			
S 6	89,654	94,715	0.95			
S 12	39,479	41,925	0.94			
A 5	69,708	76,117	0.92			
S 4	99,880	113,310	0.88			
A 1	97,576	110,741	0.88			
S 8	111,020	128,048	0.87			
S 10	64,519	75,905	0.85			
A 2	60,437	70,964	0.85			
S 2	75,254	90,720	0.83			
S 7	76,502	91,680	0.83			
S 16	92,088	113,645	0.81*			
S 18	21,090	25,988	0.81			
S 19	22,080	27,398	0.81			
S 11	64,842	81,127	0.80			
S 1	65,834	83,113	0.79			
S 13	193,344	245,700	0.79			
S 14	98,885	127,493	0.78			
A 6	76,935	98,327	0.78			
S 5	82,253	109,250	0.75			
A 3	107,543	148,828	0.72			
S 9	44,441	62,370	0.71			
S 3	94,420	135,610	0.70			
A 4	60,264	86,303	0.70			
Totals	25	\$2,007,285	\$2,443,170	20.71		
Mean	=	20.71	÷	25	=	.8284
Weighted Mean	=	\$2,007,285	÷	\$2,443,170	=	.8216
Price Related Differential	=	Mean	÷	Weighted Mean		
	=	.8284	÷	.8216	=	1.01 (rounded)

*Price-Related Differential

“When low-value properties are appraised at greater percentages of market value than high-value properties, assessment regressivity is indicated. When low-value properties are appraised at smaller percentages of market value than high-value properties, assessment progressivity results. Appraisals made for tax purposes, of course, should be neither progressive nor regressive.”

Progressive and regressive appraisal are forms of inequity called “vertical” inequity.

PTD calculates the PRD for each property category included in the study if the sample contains at least five properties. The PRD is calculated by dividing a sample’s mean ratio by its weighted mean ratio. The IAAO standard for this measure is 0.98 to 1.03, with PRDs below this range indicating progressivity, and measures above this range indicating regressivity. A PRD inside this range indicates that low-value and high-value properties are treated uniformly in regard to level of appraisal. **Table 7** shows a sample PRD calculation. In this example the PRD is 1.01, which indicates uniformity.

The IAAO warns that the PRD is not a reliable statistic when the sample is small or heavily influenced by extreme sales prices. For this reason, staff publishes the sample size on the CAD summary worksheet. The PRD is only an indicator; it alone cannot prove vertical equity or inequity. Additional tests are required to prove vertical inequity.

Step 8. — Use the Results

While the primary use of the study is to help equalize school funding, the secondary, but still very important, use of the study is for appraisal district performance evaluation. Property taxpayers may use the study to evaluate whether they are being treated fairly in comparison to owners of similar property in the same area or in other areas across the state. Taxpayers may also compare their treatment to the treatment of owners of other kinds of property. Appraisal districts and school districts may use the study to evaluate the need for reappraisal, although they should be conducting ongoing ratio studies to obtain this information on a more timely basis. The state uses the study to trigger mandatory audits and reviews in some instances.

School district officials should pay particular attention to local ratio studies, and to the PVS, because their school funding may be affected. These officials should consult with their appraisal districts on a regular basis, and work with them to

ensure that values are uniform and as close to market value as possible.

Individual Property Category Details

This section defines local properties and technical properties, and explains how PTD studies the various property categories. PTD publishes several documents that explain appraisal procedures used in the study in more detail. Contact PTD toll-free at 1-800-252-9121 or visit our Web site at <http://taxstar.cpa.state.tx.us/proptax/ptd.html> for more information.

Local properties

Local properties consist of residential properties and vacant lots, rural real property not qualified for productivity appraisal, commercial real and personal property and other taxable property. PTD field appraisers gather almost all of the data used in the local properties portion of the study. These employees, assigned to different regions throughout the state, appraise individual properties and collect sales data and other market information.

As a general rule, PTD staff will sample properties in a local property category in a school district if the category has at least 5 percent of total school district value or \$250 million in value based on the preceding year’s study. However, a category may be sampled at any time, regardless of whether its value falls within the general rule. Categories not sampled are assigned reported appraisal roll value (local value).

Residential properties and vacant lots – These properties consist of Categories A (single-family residential real property), B (multi-family residential real property) and C (vacant lots and tracts).

For each of these property categories sampled, field appraisers collect sales information and perform appraisals to develop a sample of tested parcels. Using this sample information, the staff then develops a weighted mean appraisal ratio for each category. A stratified ratio is developed whenever possible. This estimated ratio, when divided into the school district’s total self-reported value for the category, produces the staff’s estimated value for the category.

Rural real property at market value – These properties consist of the portion of Category D (rural acreage) that is appraised at market value and all of Category E (farm and ranch improvements). Although Categories D and E remain separate categories on the property value reports, these categories were merged in 1989 for study purposes. This merger

was necessary since rural improvements and land are often sold together. Consequently, this merger makes it easier to compare total sales prices for land and buildings with the total appraised values on the appraisal roll without making artificial allocations between land and buildings. Land that is qualified for productivity valuation is not appraised at market value and is discussed separately under Technical Properties, below.

PTD collects sales and performs appraisals to develop a property sample based on market values. This sample may include some property receiving productivity appraisal, but the ratios for those individual parcels are calculated on the basis of the appraisal district's reported market values, not their productivity values.

From this market value sample, PTD develops a non-stratified weighted mean appraisal ratio and divides this ratio into the school district's reported value of rural real property that did not qualify for productivity appraisal. The result is PTD's estimated market value for acreage not receiving productivity appraisal and the value of farm and ranch improvements. See below for a discussion of rural real property that is qualified for productivity valuation and that appraisal districts are not required to appraise at market value.

Commercial real and personal property – Category F1 contains commercial real property (land and improvements), while Category L1 contains commercial personal property (furnishings, fixtures, movable machinery, equipment and inventories). To estimate market values in these two categories, the staff collects sales information and, if necessary, performs appraisals for each school district category sampled. The staff develops either a stratified or non-stratified weighted mean appraisal ratio from the sampled properties and divides each school district's reported category value by the weighted mean ratio to generate PTD's estimate of category market value. This procedure is the same used to estimate value in other local property categories, with the exception of agricultural land qualified for productivity appraisal.

Complex properties

Complex properties consist of oil, gas and other mineral properties; utility properties; and qualified agricultural land. With the exception of agricultural properties, these properties are not sold often and if they are, the sales data are rarely available. As a result the staff must obtain and analyze volumes of data and develop computer models to value these

properties. PTD's Austin-based appraisers perform all of the necessary work to review and appraise these properties.

As a general rule, PTD will sample properties in each technical property category in each school district if the category has a minimum percentage of district value and a minimum dollar amount. Categories not sampled are assigned the local reported appraisal roll value.

Productivity Appraisal

Texas law requires appraisal districts to appraise property at market value. Constitutional amendments, however, allow taxation of much of the state's agricultural land based on its productive capacity rather than its market value. Chapter 23, Subchapters C and D, require appraisal of qualified agricultural land at its productivity value. Agricultural land qualified for productivity appraisal is in Category D1. These provisions require appraisal districts to classify qualified land according to its agricultural productivity, determine the net income to land for each land class over a five-year period, and capitalize the average to estimate productivity value. The Tax Code sets the capitalization rate at the greater of 10 percent or 2.5 points above the Farm Credit Bank of Texas' lending rate for December 31 of the prior year. Property taxes are based on the productivity appraisal, but appraisal districts also must estimate the market value of any land receiving productivity appraisal.

Section 23.71 of the Tax Code establishes the procedures for productivity appraisal of timberland. This process differs only slightly from the procedure for agricultural land. Timberland is classified according to soil type and the type of timber grown. For each class, the estimated net income to land is capitalized into a value per acre.

To develop the productivity ratio, PTD uses the appraisal district's report of total acreage in each of the agricultural land classes for each school district. PTD uses information provided by published sources and persons in each county who are familiar with local agricultural conditions. The division develops an estimate of net return to land over a five-year period and capitalizes the average using the legally mandated rate to reach an estimated value per acre for each land class. Multiplying the value for each class times the reported acreage in the class yields the total taxable value per land class. The total of the values for each land class is the total taxable value for all acreage receiving productivity appraisal in a school district.

On the report of property value, school districts report the total appraised value of all land receiving productivity appraisal. The division divides this reported value by its own estimate of productivity value. The resulting ratio shows the general level of appraisal of all land receiving productivity appraisal in a school district.

An appraisal district's ratio is calculated similarly and is based on the sum of the school district calculations. This ratio is not a median derived from a property sample. As a result, PTD does not calculate measures of appraisal uniformity for land receiving productivity appraisal.

Finally, PTD adds the estimated market value of rural real property not receiving productivity appraisal and the estimated productivity value for land receiving productivity appraisal. The total is the estimated total taxable value of Category D (rural acreage).

Oil, gas and other minerals – The minerals category consists primarily of oil- and natural gas-producing properties (Category G1) and lignite and sulfur mines (Category G2).

PTD samples mineral properties in school districts if the minerals category represents 5 percent or more of the total school district value. Mineral categories not meeting this criterion are assigned local value. The G1 sample is selected from the current year data provided by county appraisal districts and appraisal firms representing them. The low-value stratum is assigned the local tax roll value and contains property that makes up the lowest 5 percent of the property category's value in the school district.

After removing low-value properties, and placing high-valued properties in a separate stratum, staff stratifies the remaining properties into four strata. PTD then randomly selects the leases to be appraised for the study.

PTD uses computer models and specialized software to carry out discounted cash flow evaluations of mineral properties. Using computer models and information from a variety of sources including an in-house database, PTD calculates economic parameters such as wellhead prices, operating expenses, equipment costs, net salvage values and discount

rates. The future cash flow is generated based on forecasted production and economic parameters and then discounted to present value. The discounted equipment salvage value is then added to derive the market value for each oil and gas property. PTD may also use discounted cash flow analysis to appraise lignite and sulphur properties.

To produce the individual appraisal ratio for each minerals property in the sample, PTD divides the appraisal district's value by the estimated market value. Category G ratios are calculated similarly to Category A, but Category G is divided into three subcategories.

PTD then calculates a stratified weighted mean ratio based on the strata discussed above.

Utilities – The utilities category (Category J) consists of the real property and tangible personal property of telephone, electric, gas distribution, railroad and pipeline companies, as well as the property of other companies commonly thought of as utilities, such as water systems.

PTD chooses utility samples by a method that ensures sampling the highest-valued properties and other properties as appropriate. The division uses recognized unitary valuation methods, including the cost, income, and market approaches, as applicable. Appraisals are based on information published in annual company reports filed with federal and state regulatory agencies and furnished directly to the Comptroller by the utility companies. The division also obtains information from business and industry publications. PTD determines the percentage of unit value attributable to each company's Texas operations to develop an overall estimated value for the Texas portion of the company. Using information provided by the utilities or appraisal districts, PTD allocates this Texas value to the various school districts in which the utility owns property.

The total appraisal roll value for the sampled utility properties divided by the total estimated market values produces a non-stratified weighted mean ratio for utilities. Dividing this ratio into the school district's total reported value for utilities generates the division's estimated total value of all utility property in the school district. 🔄



Appendices

Appendix A

Selective Re-appraisal of Sales (Sales Chasing)

Beginning with the 1999 property value study, Section 403.302 of the Government Code required the Comptroller to ensure that “different levels of appraisal on sold and unsold property do not adversely affect the accuracy of the study.” Differing levels of appraisal are often referred to as unequal appraisal, and the most common cause of unequal appraisal is “sales chasing.”

Definition

Sales chasing is the practice of using the sale of a property to trigger a change in appraised value of that property to (or near) the property’s selling price. In contrast, the appraised value of unsold property is not changed. In addition to causing unequal appraisal in the CAD, the practice of sales chasing may cause invalid findings in ratio studies such as the property value study.

Effect on the Property Value Study

Sales chasing may taint the findings of ratio studies that require large samples of sales. The study depends heavily on sales because the alternative, conducting appraisals, is cost prohibitive. If a CAD is chasing sales, the sample will show appraised values at or near market value. Since the sample is made up of a subgroup of all properties in its category and this subgroup has been treated differently by the CAD than the universe of properties, this sample may not reflect the true nature of the universe of properties. The reality may be

that the majority of appraised values—unsold properties—are below or above market value. In a rising housing market, sales chasing may cause a study to arrive at an inaccurately low taxable value. Conversely, in a falling market, sales chasing may cause a study to arrive at an inaccurately high taxable value.

Study Response

PTD’s response to ensure the accuracy of the study is unaffected by unequal appraisal has two primary steps:

1. conduct one or more tests in each CAD to determine if it is likely sales chasing is occurring; and
2. adjust the sample to correct for sales chasing in districts where sales chasing is likely.

In situations in which sample adjustments are required, PTD ensures that the sample contains properties that had no chance of unequal treatment by sales chasing. This is done by including sales that occurred too late in the study year for the sales price to be used by the CAD; by including sales from sources unavailable to the CAD; or by including PTD staff appraisals.

It is important to note that even in districts in which samples are adjusted, if sold and unsold property is appraised equally at or near market value, the study findings will not be adverse to the school or CAD. 🔄

Appendix B

Questions and Answers about Margins of Error and Confidence Intervals in the Property Value Study

Definitions

95% confidence interval: The 95 percent confidence interval or range of values means that, on average, 95 out of 100 samples would result in a value within the computed range of values. The correct value is assumed to be within the computed range.

standard error: A “standard error” is a commonly used statistical term. It is a measure of the differences between an average and all the numbers that go into determining that average. Conceptually, it is somewhat similar to a coefficient of dispersion.

“t-value”: The “t-value” is an adjustment factor that increases the margin of error as the sample size decreases.

1. What is a margin of error? How is it calculated?

A margin of error (as computed in the Property Value Study) is approximately twice the “standard error” of a school district’s estimated value (in the property categories “tested”), expressed as a percentage of such value. Consequently, the margin of error indicates statistical reliability.

The following procedures are used to calculate the PTD margin of error:

- (a) Calculate the “standard error” (SE \$) of the school district’s estimated value.
- (b) Multiply the “standard error” (SE \$) by the appropriate t-value at the 95 percent “confidence interval.” (See definition above.)
- (c) Divide the product of the standard error (SE \$) and the t-value (See definition.) by the school district’s estimated value. formula = $(SE \$ * t\text{-value}) / \text{ISD } \$ \text{ estimate}$

2. How is a margin of error related to a confidence interval?

The margin of error is equal to one half of the confidence interval expressed as a percent of total value “tested” in a school district. For example, assume that PTD estimates market value in sampled and censused property categories in school district ABC to be \$100 million (before exemptions). The margin of error is computed to be plus or minus 5 percent of \$100 million. Market value plus 5 percent is \$105 million; market value minus 5 percent is \$95 million. The \$100 million estimate is known as a “point estimate”; the confidence interval of \$95 million to \$105 million is often called an “interval estimate.”

3. What is the purpose of a confidence interval?

A confidence interval provides one measure of whether the state’s estimate of value in a school district is statistically significantly different from the self-reported appraisal roll value (i.e., local value) in that district. In other words, a confidence interval is a measure of the reliability (or precision) of the Comptroller’s estimate of school district value.

Assume that Comptroller staff estimates market value in ABC school district to be \$100 million with a margin of error of 5 percent at the 95 percent confidence level. This means that the actual market value in ABC school district is probably somewhere between \$95 million and \$105 million. This range constitutes the 95 percent confidence interval. The 95 percent confidence interval means that, in repeated sampling of this school district, approximately 95 of every 100 computed confidence intervals would be expected to contain the true market value, which staff has estimated to be \$100 million, while only five would not.

If the local value in the ABC school district lies within the calculated confidence interval, then the difference between the local value and the “point estimate” of value is statistically insignificant. This means that

the Comptroller's study does not disprove local value. In this case, the Comptroller certifies ABC's local value to the commissioner of education. If the local value lies outside the confidence interval, it is considered invalid. Unless the school district is in a grace period (see page 3), the Comptroller's estimate of value is certified to the Commissioner of Education. If local value lies outside the confidence interval, the study results have disproved local value because the difference between the local value and the Comptroller's estimate is statistically significant.

The study contains a "hold harmless" feature. This means that if the school district's tested value is calculated to be within 5 percent of the PTD estimate of value, the PTD will automatically certify the school district's value. Also, if the school district's margin of error is calculated to be less than 5 percent, then the PTD will calculate (i.e., widen) the confidence interval as if it were 5 percent for purposes of certifying value. The actual percentage used in the calculation is set by management and could vary in future studies.

4. Is the target margin of error the same in every school district?

Yes. The target margin of error is also referred to as a "planned" margin of error.

5. If the target margin of error is the same in every district, is the target confidence interval the same in every district?

No, because they are expressed in different units. For example, the margin of error is expressed in percentage terms while the confidence interval is expressed in dollar terms. Assume there are two districts, ABC and XYZ. The Comptroller estimates the total value (in tested property categories) to be \$100 million (in ABC) and \$500 million (in XYZ). If the margin of error is 5 percent in both districts, the confidence interval of ABC would be \$95 million to \$105 million, while the confidence interval for XYZ would be \$475 million to \$525 million. Although the margin of error is the same for both districts, the "widths" of the confidence intervals are different because the districts' values are different. However, even if two school districts have identical margins of error and/or confidence intervals, this does not determine whether local or state value will be certified. The critical test is whether local value lies within the PTD-computed confidence interval for the district.

6. Are the confidence interval and margin of error for a school district computed on the basis of all value in the district?

No. In computing a confidence interval for a school district, staff only includes property categories whose values were estimated from representative (i.e., random) samples taken in that school district. If a property category is not tested, that category value is excluded from the confidence interval and margin of error calculations for that school district.

For example, assume a school district with a Comptroller estimate of market value of \$106 million before exemptions. Total local value in the district as shown on the self report is \$98 million. The estimated margin of error is 5 percent. Assume further that PTD does not sample any properties in Multi-family (category B) and Vacant Lots (category C) in the school district because they constitute less than 5 percent of value. The combined value of these "non-sampled" (i.e., non-tested) categories is \$6 million. "Non-sampled" property categories are assigned local value.

The confidence interval for this district is computed as follows:

$\$106 \text{ million less } \$6 \text{ million} = \$100 \text{ million}$
(the point estimate)

$\$100 \text{ million} - 5 \text{ percent}$ and $\$100 \text{ million} + 5 \text{ percent} = \95 million and $\$105 \text{ million}$ (the confidence interval).

Since the local value for the "sampled" property categories (excluding categories B and C) lies within the confidence interval, the Comptroller would certify local value for the district.

Remember that the Comptroller computes confidence intervals before deducting exemptions. If a school district's local value, before exemptions, lies within the Comptroller's computed confidence interval, then the Comptroller certifies local taxable value, after exemptions, to the Commissioner of Education.

7. Are "technical" properties treated differently than "local" properties?

Yes. In many cases, technical properties are treated as censused (i.e., "non-random") categories rather than sampled categories. (In a census, one studies every unit in a group to determine some characteristic of the group. In a sample, one studies a portion of the units in a group to estimate some characteristic of the group. Sampling requires far fewer resources than conducting a census.)

Censused properties are not used to calculate the confidence interval, but are used to calculate the margin of error. All properties in a census are studied so there is no sampling error, since the variance and standard error for censused properties is zero.

On the confidence interval detail sheet, censused properties are shown as “non-random” properties. To compute the margin of error, staff adds the value of censused properties to the combined value of the sampled property categories. One half of the confidence interval (as computed from sampled and censused properties) is divided by this total to produce the margin of error for the school district.

In effect, the censused (non-random) properties collectively comprise a separate subcategory.

All properties in the J category (utilities) as well as the D2 category (qualified agricultural acreage) sample are treated as censused properties.

8. How does the Comptroller’s use of confidence intervals affect the methodology used to select and appraise properties for the Property Value Study?

It has no effect. Confidence intervals for each school district’s market value are calculated after all sales and appraisals are entered into the system and all market values are calculated. 🌟

Appendix C

**Method Used to Compute
Confidence Intervals**

Definitions

CAD = County Appraisal District

PTD = Property Tax Division of Texas Comptroller's office

For each ISD m , $m = 1, 2, \dots$

Let h = category value stratum or total category, depending on whether stratification is used ($h=1, 2, \dots, L$)
category A, B, C, D1, F1, L1, M, G, (random portion.)

i = parcels ($i=1, 2, \dots, n_h$)

x_{hi} = CAD \$ value (local self-reported appraisal roll value) of i^{th} parcel, value stratum or category h

TX_h = total CAD \$ value, value stratum or category h

y_{hi} = PTD \$ value of i^{th} parcel, value stratum or category h

$\hat{T}Y_h$ = estimated PTD \$ value, value stratum or category h

\bar{x}_h = sample mean, CAD values, value stratum or category h

\bar{y}_h = sample mean, PTD values, value stratum or category h

N_h = total number of parcels (population), value stratum or category h

n_h = number of sample parcels, value stratum or category h

L = number of value strata/categories in a school district

$$\hat{R}1_h = \frac{\bar{x}_h}{\bar{y}_h} = \text{estimated weighted average level of appraisal, value stratum or category } h$$

$$\hat{R}2_h = \frac{\bar{y}_h}{\bar{x}_h} = \text{inverse of estimated weighted average level of appraisal, value stratum or category } h$$

$$\hat{R}2_h = 1 / \hat{R}1_h$$

S_h^2 is the PTD's measure of variability:

$$S_h^2 = RVx_h + RVy_h - 2RVx_hy_h$$

$$RVx_h = \left\{ \frac{1}{n_h-1} \left[\sum x_{hi}^2 - \frac{(\sum x_{hi})^2}{n_h} \right] \right\} / \bar{x}_h^2$$

$$RVy_h = \left\{ \frac{1}{n_h-1} \left[\sum y_{hi}^2 - \frac{(\sum y_{hi})^2}{n_h} \right] \right\} / \bar{y}_h^2$$

$$RVx_hy_h = \left\{ \frac{1}{n_h-1} \left[\sum x_{hi}y_{hi} - \frac{(\sum x_{hi})(\sum y_{hi})}{n_h} \right] \right\} / \bar{x}_h\bar{y}_h$$

Method Used to Compute Confidence Intervals

1. Compute variance (Var) of $\hat{R}2_h$ in each value stratum or category of the following property categories, if sampled: A, B, C, D1, F1, L1, M, and the randomly selected portion of G. If the PTD used value-stratified ratios in estimating category values, then compute variances by value stratum. If not, compute variances by category.

$$\text{Recall that } \hat{R}1_h = \frac{\bar{x}_h}{\bar{y}_h}; \quad \hat{R}2_h = \frac{\bar{y}_h}{\bar{x}_h}; \quad \text{and } \hat{R}2_h = 1 / \hat{R}1_h.$$

$$\text{Var} (\hat{R}2_h) = \left[\left(\frac{N_h - n_h}{N_h n_h} \right) (R2_h)^2 \right] S_h^2.$$

2. Let TX_{ran} and $\hat{T}Y_{\text{ran}}$ equal total CAD \$ value and total PTD \$ value, respectively, of all categories sampled in Step 1 above.

$$TX_{\text{ran}} = \sum_{h=1}^L TX_h$$

$$\hat{T}Y_{\text{ran}} = \sum_{h=1}^L \hat{T}Y_h$$

$$\hat{R}1_{\text{ran}} = \frac{TX_{\text{ran}}}{\hat{T}Y_{\text{ran}}}$$

$$\hat{R}2_{\text{ran}} = \frac{\hat{T}Y_{\text{ran}}}{TX_{\text{ran}}}$$

Note: The subscript “ran” denotes randomly sampled categories or representatively sampled categories.

3. Compute the variance of $\hat{R}2_{\text{ran}}$ as derived from categories sampled in Step 1.

$$\hat{R}2_{\text{ran}} = \frac{\hat{T}Y_{\text{ran}}}{TX_{\text{ran}}} = \frac{\sum_{h=1}^L R2_h TX_h}{TX_{\text{ran}}}$$

$$\text{Var} (\hat{R}2_{\text{ran}}) = \sum_{h=1}^L \left(\frac{TX_h}{TX_{\text{ran}}} \right)^2 \text{Var} (\hat{R}2_h)$$

Method Used to Compute Confidence Intervals (concluded)

4. Calculate the standard error (SE) of $\hat{R}2_{ran}$

$$SE(\hat{R}2_{ran}) = \sqrt{\text{Var}(\hat{R}2_{ran})}$$

5. Multiply $SE(\hat{R}2_{ran})$ by the "t - value" for $\hat{R}2_{ran}$ as derived from categories sampled in Step 1 above.

The t values used by the PTD are approximations to those of exact Student's t distributions with corresponding degrees of freedom. To determine the degrees of freedom, subtract the number of value strata (from stratified categories) plus the number of non-stratified categories from the combined samples. In other words,

$$\text{degrees of freedom} = \sum n_h - L.$$

6. Take the product of

$$[SE(\hat{R}2_{ran}) * t \text{ value}]$$

as a percent of $\hat{R}2_{ran}$ as derived from categories sampled in Step 1.

7. Multiply the percent obtained in Step 6 by $\hat{T}Y_{ran}$ as computed from categories sampled in Step 1. Call this ME\$.

$$ME\$ = \left\{ \frac{[SE(\hat{R}2_{ran}) * t \text{ value}]}{\hat{R}2_{ran}} \right\} * \hat{T}Y_{ran}$$

8. Recall TX_{ran} and $\hat{T}Y_{ran}$

To these two sums, add the respective appraisal roll values and the PTD values of D1 (minus timber) and the sample in category J, the non-random portion of G and parcels with an "E" flag. Let these two sums be TX_{TOT} and $\hat{T}Y_{TOT}$ respectively.

9. Compute the confidence interval for the school district. (Note: only tested categories are included in confidence interval computations.)

$$\hat{T}Y_{TOT} \pm ME\$$$

If TX_{TOT} lies within this confidence interval or within the "hold harmless" margin of error (see Appendix B, #3), TX_{TOT} is valid; otherwise TX_{TOT} is invalid.

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Texas Comptroller of Public Accounts
Publication #96-1250
Revised May 2007

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