Appendix 34

Standard on Ratio Studies

Approved April 2013

International Association of Assessing Officers

The assessment standards set forth herein represent a consensus in the assessing profession and have been adopted by the Executive Board of the International Association of Assessing Officers. The objective of these standards is to provide a systematic means by which concerned assessing officers can improve and standardize the operation of their offices. The standards presented here are advisory in nature and the use of or compliance with such standards is purely voluntary. If any portion of these standards is found to be in conflict with the Uniform Standards of Professional Appraisal Practice (USPAP) or state laws, USPAP and state laws shall govern.

Acknowledgements

At the time of the adoption of the standard by the IAAO Executive Board, the IAAO Technical Standards Committee was composed of Chair Bill Marchand; Alan Dornfest, AAS; Mary Reavey; Michael Prestridge, Dennis Deegear, Doug Warr, AAS; Chris Bennett, Staff Liaison.

The standard benefited from revisions by Robert Gloudemans and the 2011 and 2012 Technical Standard Committees.

The standard benefited from review and comment by Robert Denne, Patrick O'Connor, and Pete Davis.

Published by
International Association of Assessing Officers
314 W 10th St
Kansas City, Missouri 64105-1616

816/701-8100
Fax: 816/701-8149
http://www.iaao.org

ISBN 978-0-88329-208-2

Printed in the United States of America.

Appendix B. Outlier Trimming Guidelines

B.1 Identification of Ratio Outliers

It is first necessary to determine a procedure to identify outliers. Outlier identification based on the interquartile range (IQR) uses order statistics (see table B-1) and has been shown to be robust for a wide variety of distributions (Iglewicz and Hoaglin 1993; Barnett and Lewis 1994). The term outlier is often associated with ratios that fall outside 1.5 multiplied by the IQR. A factor of 3.0 X IQR often is chosen to identify extreme outliers. Other outlier identification procedures are found in statistical literature and can be used. Outlier identification and trimming should follow the sales validation process and precede the calculation of ratio statistics and related tests or analyses.

The example in table B-1 demonstrates the use of the 1.5 X IQR procedure to identify outlier ratios. The distribution of ratios often is skewed to the right; therefore, it may be preferable to apply appropriate transformations to the ratios prior to applying the IQR method. For example, the use of logarithmic transformations tends to identify fewer high and more low ratios as outliers.

B.2 Scrutiny of Identified Outliers

The preferred method of handling an outlier ratio is to subject it to additional scrutiny to determine whether the sale is a non-market transaction or contains an error in fact. If an error can be corrected (for example, data entry), the property should be left in the sample. If the error cannot be corrected or inclusion of the identified outlier would reduce sample representativeness, the sale should be excluded.

B.3 Outlier Trimming

Once outliers have been identified and scrutinized and any errors resolved, the next step is to exclude those that may unduly influence calculated statistical measures. For this reason, it is acceptable to trim outliers identified by recognized procedures (for cautionary notes on trimming small samples, see Tomberlin [2001] and Hoaglin, Mosteller, and Tukey [1983]. An example of such trimming is found in Table B-2. However, trimming of outliers using arbitrary limits, for example, eliminating all ratios less than 50 percent or greater than 150 percent, tends to distort results and should not be employed.

Detected outliers should be reported and can be treated in a variety of ways, including trimming (D'Agostino and Stephens 1986). If outliers are to be considered for removal, the analyst can select a procedure to trim all or just the extreme or influential outliers (see table B-2). If a trimming method has been used to reject ratios from the sample, this fact must be stated in the resulting statistical

Table B-1. A Distribution-Free Method for Locating Outliers
(The following procedure identifies outlier ratios that fall more than 1.5 times beyond the range of the middle 50 percent of the arrayed sample.)

Locating trim boundaries
Data set before trimming

Rank	Ratio (A/S)
1	0.611
2	0.756
3	0.762
4	0.853
5	0.867
6	0.909
7	0.925
8	0.944
9	1.014
10	1.052
11	1.178
12	1.367
13	1.850
14	2.500
Median ratio	**0.935**
COD	**32.271**

Steps to locate trim boundaries

1. *Locate the first quartile point*
   Formula to locate the first quartile:
   (0.25 x number of ratios) + 0.25
   (0.25 x 14 ratios) + 0.25 = 3.75
   3.75 is three-quarters between the third and fourth ranked ratios.
   Ratio 3 = 0.762
   Ratio 4 = 0.853
   Three-quarters between = (0.853 − 0.762) x 0.75 = 0.068
   The first quartile point = 0.762 + 0.068 = 0.830

2. *Locate the third quartile point*
   Formula to locate the third quartile
   (0.75 x number of ratios) + 0.75
   (0.75 x 14 ratios) + 0.75 = 11.25
   11.25 is one-quarter between the eleventh and twelfth ranked ratios.
   Ratio 11 = 1.178
   Ratio 12 = 1.367
   One-quarter between = (1.367 − 1.178) x 0.25 = 0.047
   The third quartile point = 1.178 + 0.047 = 1.225

3. *Compute the interquartile range*
   The distance between the first and third quartile = interquartile range
   1.225 − 0.830 = 0.395

4. *Establish the lower boundary*
   Lower trim point = first quartile − (interquartile range x 1.5 or 3.0)
   0.830 − (0.395 x 1.5) = 0.238,

5. *Establish the upper boundary*
   Upper trim point = (interquartile range x 1.5 or 3.0) + third quartile
   (0.395 x 1.5) + 1.225 = 1.818

Outliers identified:
1.850
2.500

Table B-2. Effects of Outlier Trimming
Outliers identified in Table B-1 trimmed

	After 1.5x trimming
Rank	***Ratio (A/S)***
1	0.611
2	0.756
3	0.762
4	0.853
5	0.867
6	0.909
7	0.925
8	0.944
9	1.014
10	1.052
11	1.178
12	1.367
Median ratio	0.917
COD	15.649

analysis. Outlier trimming is not mandatory; however, if outlier-trimming procedures are not used, sales with extreme or influential ratios must be thoroughly validated and determined to be highly trustworthy observations because they can play a pivotal role in the ratio study outcome.

B.4 Trimming Limitations

For some distributions, such as when the sample exhibits a high clustering around a specific ratio, the IQR outlier identification method is not appropriate. In such cases the IQR could be quite narrow, leading to the calculation of lower and upper boundaries for outliers and extremes that are quite close to the middle of the data. In such cases, ratios beyond those boundaries should not be automatically excluded, but instead reasonable judgment should be applied to exclude only true outliers or extremes. As one safeguard, analysts can refrain from automatically deleting any "outliers" or "extremes" inside the boundaries where 95 percent (two standard deviations) of the observations would be expected to lie, assuming a normal distribution of data.

It is also appropriate to set maximum trimming limits. For small samples, no more than 10 percent (20 percent in the most extreme cases) of the ratios should be removed. For larger samples, this threshold can be lowered to 5 to 10 percent depending on the distribution of the ratios and the degree to which sales have been screened or validated. Trim limits should be developed in consideration of the extent of sales verification.

In general, IQR-based outlier identification should be undertaken in instances in which sample sizes are sufficient to preclude the aberrant results that can be expected when this procedure is applied to small, highly variable samples.

B.5 Analytical Use of Identified Outliers

After identification, scrutiny, and correction of errors associated with outliers, the procedure can be run again to identify any remaining apparent outliers. If outlier ratios tend to be concentrated in certain areas or other subsets of the sample, they can point directly to systematic errors in the appraisal process and should be stratified and reanalyzed if they are sufficiently representative.

B.6 Reporting Trimmed Outliers and Results

Ratio study reports or accompanying documentation should clearly state the basis for excluding outlier ratios. Statistics calculated from trimmed distributions, obviously, cannot be compared to those from untrimmed distributions or interpreted in the same way.