Log-Scale and Lump-Sum Timber Selling on Federal Lands in Western Oregon

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SUMMARY

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INTRODUCTION

Considerable interest has arisen in the relation between timber-selling procedures and the accomplishment of timber-selling objectives on public lands in the West. Procedures of public agencies for measuring and paying for timber by log scale or by lump sum have attracted special attention. There are significant differences in the two procedures.

In log-scale timber selling, an estimate is made of the volume of merchantable timber in the standing trees on the tract to be sold. The purchaser agrees to pay a specific amount for each unit of merchantable volume he removes from the tract. That is, each tree or portion of a tree removed from the tract is measured (scaled) and the purchaser pays only for the merchantable volume he actually removes.

In lump-sum timber selling, an estimate is made of the volume of merchantable timber in the standing trees on the tract to be sold. The purchaser agrees to pay a specific amount for the entire tract. He pays no more nor less than that amount, no matter how much merchantable timber he actually removes from the tract.

Thus, the amount a purchaser pays and the seller receives for the timber will vary between the two procedures depending on the accuracy of measurement and the extent to which the purchaser cuts and removes volume from the tract (Table 1).

Merits and shortcomings of the two procedures have been debated at great length. Arguments for and against the two procedures are heard frequently—not all are necessarily valid.

Table 1. Effect on Unit Price and Total Price for Timber if Cut-and-Removed Volume Differs from Pre-sale Volume Estimate for Log-Scale and Lump-Sum Timber-Selling Procedures.

<table>
<thead>
<tr>
<th>Volume ratio, removed:presale estimate</th>
<th>Unit price</th>
<th>Total price</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Log-scale</td>
<td>Lump-sum</td>
</tr>
<tr>
<td></td>
<td>$/MBF</td>
<td>$/MBF</td>
</tr>
<tr>
<td>Greater than 1</td>
<td>no change</td>
<td>decrease</td>
</tr>
<tr>
<td>Equal to 1</td>
<td>no change</td>
<td>no change</td>
</tr>
<tr>
<td>Less than 1</td>
<td>no change</td>
<td>increase</td>
</tr>
</tbody>
</table>

Log-Scale Procedure

Arguments For

The purchaser pays only for what he cuts and removes, thereby lessening the risk associated with inaccurate estimates of pre-sale volumes.

Because of lessened risk, purchasers will tend to bid more for the timber.

Scaling gives a detailed account of such variables as species, log sizes, and grades of the volume removed, which aids both the seller and the purchaser in keeping inventories and payment accounts.

The timber seller will receive payment for all volume removed—regardless of the accuracy of the pre-sale volume estimate.
The timber seller doesn’t have to make costly, intensive pre-sale volume estimates—a light sampling will suffice to identify generally what is for sale.

Contract revisions tend to be simpler because payments, and thus all revisions of payments, occur at the margin and do not affect the sale as a whole.

**Arguments Against**

Because purchasers pay for everything they remove, they will tend to high-grade—that is, utilization will be less intensive.

The seller’s costs for sale administration are high because of the necessity of enforcing utilization standards.

Scaling is expensive, particularly for small and defective timber.

Scaling services may be hard to get if land ownership is scattered over a wide area and not adjacent to existing scaling facilities.

**Lump-Sum Procedure**

**Arguments For**

Because purchasers pay for the sale as a whole, they should have greater incentive to remove all volume that will at least pay its way out of the woods—utilization will tend to be more intensive.

Because of the tendency of the purchaser toward more intensive utilization, the seller’s costs for sale administration related to enforcing utilization standards will be less.

Purchasers have more flexibility in applying felling and bucking strategies, as there is no marginal cost in the form of unit payments for stumpage associated with generating unanticipated merchantability (value) for the timber on a tract.

There is an advantage for small timber, because costs for measurements and payment do not increase with the number of stems removed.

**Arguments Against**

Some degree of error always is associated with pre-sale volume measurements and, although these errors tend to average out over a large number of timber sales, a particular sale can be risky for the purchaser. That is, a purchaser may bid on the presumption that the advertised volume is accurate, but if the actual volume is less, he could lose money on the sale.

Lump-sum sales are more risky for operators who buy only an occasional timber sale than for operators who buy many sales. Lump-sum sales are believed to discriminate against operators who buy few sales.

Preparation for bidding on lump-sum sales tends to be more costly for potential purchasers than log-scale procedures. To reduce the risk of poor pre-sale volume estimates, potential bidders must inspect carefully the timber-sale site, with regard to both area and volume.

Pre-sale volume-measurement costs tend to be higher for the seller because of the need to keep sampling errors low.

Contract revisions tend to be more difficult on lump-sum sales because of the necessity of dealing with the sale as a whole.

These arguments for and against each sale type typically are voiced by public agency timber-sale administrators and timber purchasers. Not clear, is how much the arguments are
influenced by the specific policies and procedures of particular timber sellers in implementing one procedure or the other, as compared to arguments related to the overall concept of a log-scale or lump-sum procedure. For example, arguments related to contract revisions may not be inherent in the overall procedure, but instead may be related to specific contract provisions now traditionally used for that procedure. Presumably, contracts can be modified to correct these types of deficiencies.

Regardless of the origins of the arguments, the increasing interest in timber-sale procedures as factors in the accomplishment of forest-management objectives suggests the need for a closer look at some of the procedures. This need is exemplified by a recent recommendation (Reference 4) of the Public Land Law Review Commission:

'... for economic reasons and in the interest of conservation, the method of selling timber on the lump sum, or cruise, basis be adopted generally by the Federal land management agencies when selling timber.'

This recommendation is predicated on the assumptions that the lump-sum selling procedure is less costly to administer by the seller and results in more intensive utilization of timber. Although these assumptions may be theoretically correct, we have no direct evidence that existing practices support the recommendation—which brings us to the purpose of the study to be reported in this paper.

We have ample opportunity to observe the log-scale and lump-sum timber-selling procedures in practice in western Oregon. The Forest Service, U.S. Department of Agriculture, and the Bureau of Land Management (BLM), U.S. Department of Interior, have sold an average of 2.3 billion board feet and 1.3 billion board feet of timber per year, respectively, in western Oregon from 1965 through 1970. The Forest Service sells most of its timber by the log-scale procedure, and the BLM sells most of its timber by the lump-sum procedure. The purpose of this study is to analyze empirically the experiences of these agencies with the two procedures and to test specific hypotheses related to some of the arguments presented above.

**STUDY OBJECTIVES AND GENERAL PROCEDURES**

**Objectives**

The primary objective of this study was to test the following three hypotheses:

1. No significant difference exists between the volume of logging residue on clearcuttings sold by the lump-sum procedure and on clearcuttings sold by the log-scale procedure.
2. No significant difference exists between costs of sale preparation and administration when timber is sold by the lump-sum procedure and when timber is sold by the log-scale procedure.
3. No significant difference exists between the bid prices for timber sold by the lump-sum procedure and bid prices for timber sold by the log-scale procedure.

**General Procedures**

Forest Service personnel and timber-sale reports were the sources of data on the log-scale procedure; BLM personnel and timber-sale reports were used as the data sources for the lump-sum procedure. Because of the inherent variability of timber sales with regard to such things as timber quality, local markets, logging practices, logging conditions, and contractual requirements, generalizations over a wide area about the impacts of one sale procedure compared to another are risky. For example, published data show that gross volumes of logging residues on Forest Service clearcuttings in western Oregon and western Washington

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averaged 4,511 cubic feet per acre, compared to 2,677 cubic feet per acre for clearcuttings on “other public lands,” which are predominately BLM lands (2). Based on this evidence, one may choose to accept the hypothesis that less logging residue is left when timber is sold by the lump-sum procedure. The samples from which these estimates were inferred, however, cover a wide variety of timber-sale conditions and there is no assurance that the populations of timber sales for the two ownership classes are comparable. That is, the objective of the sampling was not oriented toward answering the question, “Given a specific timber sale—will the lump-sum procedure result in less logging residue than the log-scale procedure?”

The ideal way to answer the question would be to observe both procedures on the same timber-sale area at the same time, with all other factors equal. This also would be the way to test the hypotheses related to sale administration costs and bid prices. The ideal way, however, is not feasible, so the decision was made to approximate the ideal by observing timber-sale areas and specific timber sales. The sales were chosen carefully to reduce the variability from factors other than those being studied on the areas and timber sales to be compared. Log-scale and lump-sum areas and timber sales were paired to reduce variability resulting from:

- timber type and quality,
- marketing area and conditions;
- type of cut—clear, partial, etc.;
- sale size in terms of pre-sale volume estimate;
- sale area development—roads, etc.; and
- time sale was made and cut.

Overriding considerations in dealing with these factors are sale location and timing. Location is related closely to timber type and quality and marketing area and conditions. It also is related somewhat to type of cut, sale size, and sale-area development. Timing is related closely to market conditions that might influence intensity of utilization, costs, and prices.

**Choosing the Timber Sales**

The period January 1, 1965, through December 31, 1968, was chosen as the interval from which to choose specific timber sales to study. This period was chosen because data were easily available and variance within timber-sale procedure should be low because no significant changes in sale procedures that would affect the three hypotheses were known to have occurred during that period. Furthermore, one of the requirements for testing the hypothesis related to logging residue was that the sales being analyzed must be completely closed out. Because most sale contracts last from 2 to 3 years, most sales made after 1968 would not have been closed out at the time of this study in 1970.

The areas and sales to be compared had to be as close together as possible, so the samples had to be chosen only from areas of intermingled Forest Service and BLM ownership. Thus, the first approximation of comparison areas was made by identifying places where the Forest Service and BLM had common property lines (roughly, where they at least lay in adjacent townships).

There were 21 possible paired groupings of sales with common property lines from Salem on the north to the California border on the south and between the crest of the Cascade Mountains and the Pacific Ocean on the east and west. All timber sales in each of the paired groupings were analysed during the period 1965 through 1968 to see whether comparable sales existed.

The analysis narrowed the number of feasible paired groupings down to seven. The samples were distributed from Salem to slightly south of Roseburg, with one grouping on the Coast Range slopes and six on the western slopes of the Cascade Range.

An intensive analysis was made of the sales within these seven groupings to find individual pairs of sales that were comparable. Six pairs of sales were chosen.
In summary, the samples chosen for analysis included seven comparison areas, where a comparison area is defined as a grouping of log-scale and lump-sum timber sales for 1965 to 1968 in essentially the same geographic area. The average conditions for the grouping within sale procedure were as close as possible.

The samples also included six paired sales, where paired sales were a single log-scale sale and a single lump-sum sale having sale conditions as similar as possible.

The reason for choosing paired sales in addition to comparison areas was related to the technique followed in testing the hypotheses. This should become apparent when the test of each hypothesis is discussed.

**HYPOTHESIS TEST PROCEDURES AND STUDY RESULTS**

**Volume of Logging Residues**

The first hypothesis to be tested was that there is no significant difference between the volume of logging residue on clearcuttings sold by the lump-sum procedure and on clearcuttings sold by the log-scale procedure.

**Procedure for testing the hypothesis**

Each clearcut unit on each of the 12 sales comprising the 6 paired sales was sampled to estimate the gross cubic feet of softwood residue volume in pieces at least 4 inches in diameter and 4 feet long. No attempt was made to distinguish a net or sound volume of residue, because timber in the paired sales was assumed to be similar in type and quality and thus would not differ significantly in the gross-net relation.

Residue volume was sampled by the line-intersect method (References 1, 5, 6). The basic method, however, which assumes a random distribution of residue pieces, was modified because preliminary observations of some sample sales showed that random distribution could not be expected. Some of the units were very steep, and residue tended to be concentrated in the draws and around the landings, although there had been no intentional piling of debris before burning, as is done now.

The modification of the basic method consisted of using a 10-chain by 5-chain grid to establish plot centers over each unit. From each plot center, a sample line was run 100 feet north and 100 feet east. The grid and the L-shaped sample line assured adequate coverage of the residue volume in each unit. The sample design aimed at one plot per 5 acres in each clearcut unit. The post-sampling analysis showed that the coverage was about one plot to 6.8 acres. The discrepancy arises from a combination of the inadequacy of the rectangular sampling grid for irregularly shaped clearcuttings, particularly small units, and the possibility that the actual acreage of some clearcut units differ from that estimated in the timber-sale reports. We believed that the apparent lightness of the samples had no significant effect on the paired-sale comparisons. If the objective had been to estimate the absolute levels of residue volume, the results would have been impaired somewhat, but for this study, the objective merely was to compare the relative residue volumes on two sales that were sampled in exactly the same way. Altogether, there were 670 acres in the log-scale sample and 636 acres in the lump-sum sample.

One other qualification of the results should be noted. Most of the units sampled had been burned. The objective was to estimate the volume before burning for each unit. Therefore, each piece tallied that had been burned was reconstructed mentally to its pre-burned dimensions by surrounding evidence. The burned and unburned diameter was recorded for each burned piece. Because no data were collected for pieces less than 4 inches in diameter or 4 feet in length, there should have been little loss of data because of a piece burning completely. Although larger logs may be burned through at various points, they may be completely unscorched at other points along their length, thus making possible an estimation of the pre-burned dimensions.
Results
A two-factor analysis of variance with F-tests of the six paired sales showed no significant difference at the 95 percent level of probability between the average residue volumes left on the lump-sum sales and the log-scale sales (Table 2). Furthermore, there was no significant difference between the average residue volumes left at the six general locations of the paired sales.

Table 2. Estimated Softwood Residue Volumes in Cubic Feet per Acre Left on Lump-Sum and Log-Scale Timber Sales, by Sale Pair.

<table>
<thead>
<tr>
<th>Sale procedure</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>Avg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lump-sum</td>
<td>2,054</td>
<td>3,620</td>
<td>5,190</td>
<td>4,720</td>
<td>3,000</td>
<td>4,901</td>
<td>3,862</td>
</tr>
<tr>
<td>Log-scale</td>
<td>2,170</td>
<td>3,640</td>
<td>6,135</td>
<td>2,042</td>
<td>2,419</td>
<td>5,940</td>
<td>3,384</td>
</tr>
<tr>
<td>Average</td>
<td>2,106</td>
<td>3,630</td>
<td>5,583</td>
<td>3,232</td>
<td>2,628</td>
<td>4,360</td>
<td>3,598</td>
</tr>
</tbody>
</table>

Notice, however, that although for three sale pairs, the lump-sum procedure resulted in the most volume of residue left, on the other three sale pairs, the log-scale procedure resulted in the higher volumes. This strongly suggests the possibility that other factors beside the sale measurement-payment procedure may have a strong influence on utilization. Two other factors that might be suspected of having a significant influence are the logger and the time logging takes place. The logger is a factor in terms of such things as his equipment, techniques, alternatives for wood use, and distance from the sale. Time is a factor in that market conditions for wood products vary over time such that log sizes and grades uneconomic to remove from the sale site at one time may become economic to remove at another time.

Although this study wasn't designed specifically to test the difference in residue volume by bidder and time of sale, note that there were six separate successful bidders for the log-scale sale and the lump-sum sale (Table 3). The year of sale and the successful bidder for the sales comprising sale pair B were identical. The volume of residue on each of the sales was also virtually identical (Table 2). On the other hand, despite the identical successful bidders for the sales comprising sale pair D, the volume of residue left on each of those sales had the greatest

Table 3. Summary of 12 Sales in Paired-Sale Analysis by Year Sale Was Made and Successful Bidder.

<table>
<thead>
<tr>
<th>Sale pair</th>
<th>Year of sale</th>
<th>Successful bidder</th>
<th>Year of sale</th>
<th>Successful bidder</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1965</td>
<td>U</td>
<td>1965</td>
<td>V</td>
</tr>
<tr>
<td>B</td>
<td>1966</td>
<td>W</td>
<td>1966</td>
<td>W</td>
</tr>
<tr>
<td>C</td>
<td>1965</td>
<td>X</td>
<td>1968</td>
<td>X</td>
</tr>
<tr>
<td>D</td>
<td>1967</td>
<td>X</td>
<td>1965</td>
<td>X</td>
</tr>
<tr>
<td>E</td>
<td>1967</td>
<td>X</td>
<td>1965</td>
<td>Y</td>
</tr>
<tr>
<td>F</td>
<td>1965</td>
<td>Z</td>
<td>1966</td>
<td>Z</td>
</tr>
</tbody>
</table>

1There were six separate successful bidders for all 12 sales. The 6 bidders are designated by the letters U through Z.
difference of any sale pair. Other interesting conclusions may be drawn by comparing Tables 2 and 3. These observations serve only to suggest other factors that might have an impact on the amount of residue volume of clearcuttings.

Conclusion

The hypothesis that there is no significant difference in residue volumes on lump-sum and log-scale sales is accepted. This result should be interpreted with the recognition that many interdependent variables can affect the amount of residue left on a given timber sale. The simple decision to use log-scale or lump-sum procedure by itself is not likely to have much impact on logging residue volumes.

Costs of Preparation and Administration

The second hypothesis to be tested was that there is no significant difference between the seller's costs for sale preparation and administration when timber is sold by the lump-sum procedure and when timber is sold by the log-scale procedure.

Procedure for testing the hypothesis

The major direct cost associated with sale preparation and administration is manpower. Therefore, manpower requirements were used as a surrogate for costs in testing the hypothesis relating to the preparation and administration of timber sales made under each procedure. Forest Service timber-sale administrators were interviewed for log-scale sale data; BLM timber-sale administrators were interviewed for lump-sum sale data. The sample was comprised of sale administration people working in the seven comparison areas identified earlier.

An interview guide was prepared for two major types of timber sales, clearcuttings and intermediate cuttings. The objective of the guide was to focus the attention of the interviewee on a specific timber-sale situation and have him estimate manpower requirements for the specified activities related to sale layout, cruising, and timber sale administration.

For the clearcutting interview guide, all interviewees were asked to answer all questions with regard to a timber sale having the following characteristics:

- Type of sale: Clearcutting
- Area: 60 acres
- Gross volume: 4.5 million board feet, Scribner log rule
- Gross volume per acre: 75,000 board feet, Scribner log rule
- Other characteristics: All other characteristics of the sale, such as species composition, timber quality, and terrain should be regarded as the average for clearcuttings in the general area described under "sale location.

Sale location: The entry here depended on the comparison area that the interviewee represented. He was referred to a specific area in his management jurisdiction by a legal description of the area.

An investigation before constructing the interview guide showed that all interviewees should have been able to identify with the sale as described. That is, the sale fell within the range of actual experience for clearcuttings in all the comparison areas. By having the log-scale experience and lump-sum experience focused on this particular sale in a particular area, the variability because of factors other than sale procedure should have been reduced.

The intermediate cut interview guide proved more difficult to construct and work with. Because experience with intermediate cuttings is highly variable between forest-management districts, not all interviewees could be expected to identify with a contrived situation as was done for clearcuttings. Therefore, the interviewees were asked to construct the situation for the average intermediate cut in the vicinity of the sale location specified for the clearcuttings.
They were further asked to stratify intermediate cuts by:

- Commercial thinning
- Shelterwood cutting
- Pre-logging.

An average situation was to be specified for each type of intermediate cut practiced in the area specified. We anticipated that commercial thinning would be the only type of intermediate cut for which comparison data would be available. The purpose of stratifying was to insure that the interviewee focused on commercial thinning and did not lump all intermediate cutting together in formulating his answers.

The interviewee was asked to provide the best answers he could, based on his experience, of the number of man-hours that would be spent in the sale activities specified on the interview guides. The answers were to relate only to the specified timber sale for clearcuttings and the average situation described by the interviewee for intermediate cuts. The activities specified on the interview guides for each sale type were:

**Sale Layout and Cruising (Sale Preparation)**
- Sale layout (recon, boundary marking, traverse, etc.)
- Cruising (including marking on intermediate cuts)
- Check cruising

**Sale Administration**
- Preparation after the sale is bought, but before active logging (meeting with successful bidder, sale area visits, etc.)
- Sale area visits during active logging (cursory inspections, public relations, etc., but does not include making field measurements.)
- Sale area inspection during active logging (general inspection and field measurements; e.g., checking stump heights, log trim, trespass, and other utilization requirements. Also includes measurement and other activities related to contract modification, penalties, etc.)
- Timber volume measurement (scaling, check scaling, keeping track of payment blocks or any other activities related to keeping track of volume removes)\(^2\)
- Timber volume accounting and billing (preparation of statements of account and billing the purchaser, including time spent checking and reviewing the accounts and billings)
- Final inspection and sale close-out (includes final acceptance of sale performance and final inventory accounting)

The intent of specifying detailed activities on the interview form was not to get specific data for each activity, but rather to insure that no activities were left out by the interviewee in formulating his overall answer. The specified activities were chosen on the basis of preliminary interviews with timber sale administrators. The objective was to include only activities that could be expected to differ significantly in manpower requirements between log-scale and lump-sum sales. The comparisons were to be made for the two major activities, sale preparation and sale administration.

An attempt was made to make sure that interviewees did not mingle their estimates of "actual" practice with their knowledge or opinions of "what ought to be." They were asked to estimate both the man-hours required based on actual current practices and the man-hours

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\(^2\)Scaling of all material removed usually is done, no matter whether timber is sold by the log-scale procedure or the lump-sum procedure. The scaling in the area studied usually is done by an independent scaling bureau. The cost of scaling is allowed for in the appraisals of both log-scale and lump-sum sales. Therefore, the only scaling included in this item is that related to a particular sale procedure; e.g., check scaling is a common activity for the log-scale procedure and uncommon for the lump-sum procedure.
they believed would be required if they were justifying an ideal operation using the sale procedure for which they were replying; that is, log scale or lump sum. This proved to be a good precaution. Some interviewees were surprised at their answers for current practices, and there was a tendency to want to change them to coincide more closely with their opinions of what they thought were regional standards. The risk of getting such qualified answers was minimized by the requirements of the interview guide and the method of interviewing.

Interviewees were told by telephone about the nature of the study and were asked to cooperate by supplying data. An appointment then was made for a field representative to interview the person contacted. A copy of the interview guide was mailed to the interviewee in advance of the field representative’s visit. The interviewee was asked to study the guide and gather any data, personnel, or background he needed to answer the questions. Tentative answers to the questions should have been prepared by the time of the field representative’s visit. The field representative then interviewed the timber sale administrator and any others needed to answer the questions, filling in the answers on a blank interview guide himself. A typical interview included a district ranger (manager), a timber sale administrator, and pre-sale specialist. By going over each question and writing the answers himself, the field representative reduced the chances that a question or the context of a question was misunderstood.

Results

Clearcutting interviews. The statistical analyses of the clearcutting sale interviews for the seven comparison areas showed the following:

There was no significant difference between the log-scale and lump-sum procedures with regard to:

- Actual total manpower requirement
- Ideal total manpower requirement
- Actual sale administration manpower requirement
- Ideal sale administration manpower requirement

There was a significant difference between the log-scale and lump-sum procedures with regard to:

- Actual sale preparation (layout and cruising) manpower requirement (at the 95-percent level of confidence)
- Ideal sale preparation (layout and cruising) manpower requirement (at the 99-percent level of confidence)

There was no significant difference between comparison area locations with regard to total and sale preparation or sale administration manpower requirements, actual or ideal.

The results are summarized in Tables 4 and 5.

Based on the statistical analysis, the overall hypothesis regarding the seller’s total sale preparation and administration costs is accepted—that is, there is no significant difference between the two sale procedures. This suggests that over a large timber sale program using clearcutting, total timber sale preparation and administration costs are not likely to differ significantly, regardless of whether the log-scale or lump-sum procedure was followed.

The analysis of individual cost components, that is, sale preparation and sale administration, suggests that higher costs of sale preparation are associated with lump sum sales—a result to be expected because of the more intensive sale-boundary marking and cruising usually done on lump-sum sales. On the other hand, sale administration costs tend to be lower on lump-sum sales, which is shown by the result that total costs of sale preparation and administration do not differ significantly.

3The statistical test was a 2-factor analysis of variance with F-tests between sale procedures (1 degree of freedom) and between comparison area location (6 degrees of freedom).
Table 4. Estimated "Actual" Man-hour Requirements for a Specified Clearcutting at Seven Comparison-Area Locations, by Timber Sale Activity and Sale Procedure.

<table>
<thead>
<tr>
<th>Comparison area</th>
<th>Sale preparation</th>
<th>Sale administration</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Log scale</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lump sum</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Log scale</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lump sum</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Log scale</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lump sum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>104</td>
<td>120</td>
<td>224</td>
</tr>
<tr>
<td>2</td>
<td>72</td>
<td>169</td>
<td>241</td>
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<tr>
<td>3</td>
<td>85</td>
<td>255</td>
<td>340</td>
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<td>4</td>
<td>64</td>
<td>262</td>
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<td>5</td>
<td>50</td>
<td>181</td>
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<td>6</td>
<td>183</td>
<td>78</td>
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<tr>
<td>7</td>
<td>142</td>
<td>159</td>
<td>301</td>
</tr>
<tr>
<td>Average</td>
<td>100</td>
<td>175</td>
<td>275</td>
</tr>
</tbody>
</table>

The contrast between the actual and ideal estimates are interesting in several respects. Recall that the actual estimate is based on present anticipated performance using the sale procedure in question and that the ideal estimate is based on the assumption that the resources could be made available to improve the present performance using the same sale procedure in any way that the interviewee saw fit.

Table 5. Estimated "Ideal" Man-hour Requirements for a Specified Clearcutting at Seven Comparison-Area Locations, by Timber-Sale Activity and Sale Procedure.

<table>
<thead>
<tr>
<th>Comparison area</th>
<th>Sale preparation</th>
<th>Sale administration</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Log scale</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lump sum</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Log scale</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lump sum</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Log scale</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lump sum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>48</td>
<td>129</td>
<td>177</td>
</tr>
<tr>
<td>2</td>
<td>80</td>
<td>272</td>
<td>352</td>
</tr>
<tr>
<td>3</td>
<td>56</td>
<td>286</td>
<td>342</td>
</tr>
<tr>
<td>4</td>
<td>48</td>
<td>468</td>
<td>516</td>
</tr>
<tr>
<td>5</td>
<td>42</td>
<td>638</td>
<td>680</td>
</tr>
<tr>
<td>6</td>
<td>123</td>
<td>106</td>
<td>229</td>
</tr>
<tr>
<td>7</td>
<td>108</td>
<td>181</td>
<td>289</td>
</tr>
<tr>
<td>Average</td>
<td>72</td>
<td>297</td>
<td>369</td>
</tr>
</tbody>
</table>
The interviewees were instructed to make their ideal estimates as though they would have to justify any proposed changes both in terms of improved performance and the cost-effectiveness of the changes they proposed. Viewed in this context, one can conclude from the data that the aggregate impact of the proposed changes would lessen the difference in total manpower requirement between the log-scale and lump-sum procedure; the ratio of log-scale to lump-sum manpower requirement would increase from 0.76 to 0.95 (Table 6). The change in the ratio would result mainly from a 69-percent increase in sale administration manpower for the log-scale procedure in the context of a small increase in the same item for lump-sum sales and a decline of sale-preparation manpower for both the log-scale and lump-sum procedures (Table 4 and 5). Overall, log-scale-procedure interviewees indicated that their performance could approach ideal with a 34-percent increase in total manpower, but lump-sum interviewees indicated that their ideal performance could be approached with an 8-percent increase in total manpower (Table 6). For both sale procedures, the approach to ideal required tightening sale administration, that is, monitoring logging practices more closely, and decreasing sale-preparation intensity.

Intermediate-cut interviews. The original plan had been to derive a composite thinning sale from the responses to the interview guide and run an analysis parallel to that done for the clearcutting sale. Variability of the responses coupled with a total lack of intermediate cut experience by four interviewees, however, forced a change in plans.

We decided to aggregate what data there were by sale procedure and compare the average estimated actual manpower requirements for each procedure. The ideal manpower estimates had little meaning, because even though some interviewees could envision radical changes in marking, cruising, and scaling, they had no experience on which to base estimates of changes in manpower requirements.

The results for each sale procedure were aggregated for analysis in terms of a composite thinning-sale situation (Table 7). The estimates of actual manpower requirements for each composite sale were calculated in two ways: average manpower requirement per acre; and average manpower requirement per thousand board feet, Scribner, of harvest volume. Without statistical analysis, the results showed that (Table 8):

Sale preparation averages more man-hours for the lump-sum procedure than for the log-scale procedure, both by the acre and by the thousand board feet, harvest volume.

Table 6. Man-hour Requirement Ratios for a Specified Clearcutting by Sale Procedure and Type of Estimate.¹

<table>
<thead>
<tr>
<th>Manpower requirement</th>
<th>Ratio, log scale to lump sum</th>
<th>Ratio, &quot;Ideal&quot; to &quot;Actual&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&quot;Actual&quot;</td>
<td>&quot;Ideal&quot;</td>
</tr>
<tr>
<td>Total</td>
<td>0.76</td>
<td>0.95</td>
</tr>
<tr>
<td>Sale preparation</td>
<td>0.43</td>
<td>0.32</td>
</tr>
<tr>
<td>Sale administration</td>
<td>1.34</td>
<td>1.83</td>
</tr>
</tbody>
</table>

¹Derived from the data in Tables 5 and 6.
### Table 7. Composite Thinning Sales, by Sale Procedure.

<table>
<thead>
<tr>
<th>Sale Procedure</th>
<th>Observations</th>
<th>Stand age</th>
<th>Stand volume</th>
<th>Sale area</th>
<th>Volume cut(^1)</th>
<th>Volume cut(^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log scale</td>
<td>6</td>
<td>97</td>
<td>62</td>
<td>262</td>
<td>17</td>
<td>27</td>
</tr>
<tr>
<td>Lump sum</td>
<td>4</td>
<td>70</td>
<td>48</td>
<td>125</td>
<td>13</td>
<td>27</td>
</tr>
</tbody>
</table>

\(^1\) Per acre; Scribner log rule.
\(^2\) As a percentage of the initial volume.

For purposes of comparison, note that the overall results for the clearcutting analysis averaged 0.06 and 0.08 man-hours per thousand board feet of harvest volume for the log-scale and lump-sum procedures, respectively.\(^4\) Comparing this with the requirement of 0.13 and 0.24 man-hour for thinning sales indicated that thinning-sale costs per thousand board feet of harvest volume may be from 2 to 3 times those for clearcuttings when existing practices are followed for sale preparation and administration.

**Summary**

The results of this analysis of costs for sale preparation and administration should be qualified by an awareness that coincident to sampling the log-scale procedure and the lump-sum procedure, the study also was sampling the practices of two different government agencies. That is, any differences or lack of them may be attributable more to the overall rules, procedures, and policies of the two agencies than to the sale procedures alone. This idea was discounted in setting up this study, because of the assumption that, although each agency probably is not an optimum practitioner of its particular sale procedure, it had evolved the procedure under general objectives of efficiency. Thus, a change from one procedure to the other probably would incorporate most of the ideas and practices used by the agency already having the procedure. This is not to say that each sale procedure cannot be made more efficient, and that any moves toward greater efficiency would not change the results of this study. The main point is that the best basis we have for predicting the outcome of a procedure is to observe it where it has been in use, which is what has been done here.

### Table 8. Estimated Actual Man-hour Requirements per Acre and per Thousand Board Feet Harvest Volume for Composite Thinning Sales\(^1\) by Timber Sale Activity and Sale Procedure.

<table>
<thead>
<tr>
<th>Basis</th>
<th>Sale preparation</th>
<th>Sale administration</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Log scale</td>
<td>Lump sum</td>
<td>Log scale</td>
</tr>
<tr>
<td>Acre</td>
<td>1.15</td>
<td>2.07</td>
<td>1.05</td>
</tr>
<tr>
<td>M bd ft(^2)</td>
<td>0.07</td>
<td>0.16</td>
<td>0.06</td>
</tr>
</tbody>
</table>

\(^1\) Specifications are in Table 7.
\(^2\) Harvest volume.

\(^4\) These figures were derived from Table 4 in conjunction with the volume and acreage description of the clearcutting sale used in the interview guide.
Bid Prices

The third hypothesis to be tested was that there is no significant difference between bid prices for timber sold by the lump-sum procedure and by the log-scale procedure.

Procedure for testing the hypothesis

As with the logging-residue-volume analysis, the analysis of bid prices would best be made by seeing what the bids of a single bidder would be for identical timber sales sold under the log-scale and lump-sum procedures. Because this method was impractical, the analysis was made by comparing bid prices for Douglas-fir on the same paired sales and comparison areas that were used in the previous analyses.

A comparison of bid prices on Forest Service (log scale) and BLM (lump sum) timber sales is not as simple as it seems. To make the bids comparable, adjustments must be made to account for the following differences:

1. The base of the advertised sale volume (cruise). The Forest Service assumes a basic log length of 32 feet; the BLM assumes a basic log length of 16 feet. In scaling, logs are to be measured only at the small end, so log taper will result in less volume accounted for when 32-foot-log measurement is used. Therefore, to make volume estimates comparable for this study, 16-foot basic volume was adjusted to a 32-foot-log basis by the following relation:

   Volume on a 32-foot basis = 0.83 (Volume on a 16-foot basis)

   This is an average adjustment factor for Douglas-fir worked up from volume tables and has been used elsewhere.

2. The time a sale was made. Timing has an impact on bid prices because bids are formulated in the context of current market conditions and future expectations. Therefore, to make bid prices comparable with regard to time, adjustment factors were developed from the Douglas-Fir Monthly Regional Index of Western Wood Products Association. All bid prices were adjusted to a 1966-1967 average basis.

3. Apparent intrinsic timber value differences between sales being compared. Despite the care taken in choosing comparable sale pairs and comparison areas, there still may be some inherent differences in timber values for the sales or areas being compared, because of local factors that may influence such items as logging difficulty and transportation. The basic timber appraisals, properly adjusted, were chosen as indicators of intrinsic differences in timber value. The process for adjusting the appraisals was:

   Adjust appraised values to 32-foot volume basis.
   Adjust appraised values for time (as above).
   Add road construction and other development costs (adjusted to 32-foot basis) back into the appraised stumpage values to yield comparable values related to the timber itself.
   Adjust bid values to reflect indicated timber value difference.

   This is an admittedly crude adjustment, but it seems to be the most efficient way of taking into account value differences attributable to things such as logging difficulty.

   Assumptions, other than those indicated by the above adjustments, made for this analysis are:

   Bidders take the cruise volume basis (32-foot log or 16-foot log) into account when bidding. That is, if all factors are adjusted to a 32-foot log basis, then a bidder viewing a sale of one million board feet (16-foot-log basis) is assumed to bid as though he is bidding for 83

5 Logs in this study were measured by the Scribner Decimal C log rule in board feet, abbreviated bd ft, or in thousands of board feet, M bd ft
percent of that, or 830 thousand board feet on a 32-foot-log basis. Thus, if he bid $50 per thousand board feet (16-foot-log basis), that is interpreted as a bid of $60.24 per thousand board feet (32-foot-log basis), or

\[ \frac{50 \times 1,000}{M \text{ bd ft (16-ft)}} \cdot \frac{M \text{ bd ft (32-ft)}}{830} = \frac{60.24}{M \text{ bd ft (32-ft)}} \]

The expected competition (number and types of bidders) for the sales being compared is comparable. This is an important assumption, because studies have shown that number of bidders is an important variable with regard to bid prices (3). The assumption should be valid for this analysis because the expected market (bidders) for both the paired sales (see Table 3) and the comparison areas are the same.

Finally, some allowance had to be made in the analysis of bid prices for the variation that can be expected on lump-sum sales between the unit price bid and the unit price actually paid for a timber sale (see Table 1). That is, a bidder may bid one price per thousand board feet on a lump-sum sale, but end up paying another price per thousand board feet because the volume cut turns out to be different from the pre-sale volume estimate. On log-scale sales, the unit price bid is always the same as the unit price paid.

The comparison of bid and paid prices on lump-sum sales requires knowing the volume actually cut. Most successful bidders on BLM sales notify the BLM of the volume removed from the sale. There was some question about the validity of those reported volumes, however. There was a possibility of error either because of the volume-measurement base (32-foot or 16-foot basis), or the manner in which the estimate was obtained (Bureau scale, company scale, or a rough estimate). Questionnaires were sent to all successful bidders for the sales in this analysis asking for a report of the volume cut and the specific basis for that volume estimate. Discrepancies indicated by the responses were negligible—almost all reported cut volumes were based on independent scaling bureau measurements on a 32-foot basis.

Thus, three comparisons could be made:
- Log-scale bid price and lump-sum bid price.
- Log-scale paid price and lump-sum paid price.
- Lump-sum bid price and lump-sum paid price.

Results

The analysis of bid prices on Douglas-fir for both the six paired sales and the seven comparison areas showed (Tables 9 and 10):

- No significant difference in the log-scale bid prices and the lump-sum bid prices.
- No significant difference in the log-scale paid prices and the lump-sum paid prices.
- No significant difference in the lump-sum bid prices and the lump-sum paid prices.

These results apply to an overall timber sale program. A decision-maker at the margin may be interested in some observations of the raw data (Tables 9 and 10). For example, inspection of the data shows a lack of any consistent pattern between the bid or paid prices that are compared. In some areas, bid prices for lump-sum sales were higher than for log-scale sales and in other areas, the reverse occurred. Also, there was no apparent consistency in whether the successful bidder on lump-sum sales ended up paying more or less per thousand board feet than he bid: For lump-sum sales in the paired sale group, the successful bidder paid 96 percent of his bid; for all lump-sum sales within comparison areas, the average paid price was 7 percent higher than the average bid price.

6The paired sale and the comparison-area analyses were subjected to the t-test for paired plots. There was no significant difference in any test at the 95-percent level of confidence.
Table 9. Bid Prices in Dollars per Thousand Board Feet, Scribner, 32-ft basis, for Douglas-fir, for Sales Made by Log-Scale and Lump-Sum Procedure, Paired-Sale Analysis.

<table>
<thead>
<tr>
<th>Sale procedure</th>
<th>Bid prices by sale pair</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td>Log scale</td>
<td>16.07</td>
</tr>
<tr>
<td>Lump sum</td>
<td></td>
</tr>
<tr>
<td>Bid</td>
<td>38.06</td>
</tr>
<tr>
<td>Paid&lt;sup&gt;1&lt;/sup&gt;</td>
<td>41.60</td>
</tr>
</tbody>
</table>

<sup>1</sup>The amount actually paid is based on the volume actually cut. The calculation is as follows: Paid price = (Bid price) (Cruise volume, 32-ft basis)/(Volume cut, 32-ft basis).

Table 10. Bid Prices in Dollars Per Thousand Board Feet, Scribner, 32-Foot Basis, for Douglas-Fir, Lump-Sum Procedures, Comparison-Area Analysis.

<table>
<thead>
<tr>
<th>Sale procedure</th>
<th>Average bid prices by comparison area</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Log scale</td>
<td>59.03</td>
</tr>
<tr>
<td>Lump sum</td>
<td></td>
</tr>
<tr>
<td>Bid</td>
<td>43.41</td>
</tr>
<tr>
<td>Paid&lt;sup&gt;1&lt;/sup&gt;</td>
<td>34.59</td>
</tr>
</tbody>
</table>

<sup>1</sup>See footnote for Table 9.

Summary
The lack of significant differences for all the comparisons suggests that for an overall timber sale program, differences in prices bid and paid because of sale procedure tend to average out. That is, the return to stumpage is not influenced directly by the two sale procedures considered in this study.

SUMMARY
This paper can be summed up as a report of nonsignificant differences. The study was an attempt to deal empirically with some of the common arguments for and against log-scale and lump-sum timber-selling procedures. In terms of the aspects studied, the results are fairly conclusive in support of an argument that there is no particular advantage for one procedure or the other in the context of large timber-sale programs such as those of the Forest Service and the Bureau of Land Management.

But this paper should not be interpreted as the final word to fit all situations. The analyses were designed to answer questions regarding an overall timber-sale program, that is, broad policy questions such as whether one procedure is better than the other with regard to the criteria tested. The results are not directed at the marginal decision of whether to use one procedure or the other on the next timber sale to be made. That decision has to be based on specific timber-sale objectives, the manpower and other resources available, the characteristics...
of the timber sale and the market, the availability of scaling facilities, and so forth. This suggests that rather than limiting a timber manager to one procedure or the other, as is often recommended, the manager should be given the flexibility of choosing the procedure that best fits the circumstances he is dealing with. This is done already to a limited extent by the public agencies. The point is that there appears to be no advantage to eliminating whatever flexibility now exists in favor of a rigid policy of one sale procedure or the other.

This study suggests some areas for further study. The study seems to discount some of the accepted theory about log-scale and lump-sum procedures. This should raise questions of why the observed practices don't support the theory. For example, if one were to design procedures for log-scale and lump-sum timber sales from scratch, one could theoretically expect to allocate less resources to sale administration for the lump-sum procedure. Why, then, has the lump-sum procedure observed in this study evolved to the point where there is no apparent advantage over the log-scale procedure in manpower requirements for sale administration? Is it because more men are needed than one can anticipate to insure that timber-sale objectives are being accomplished? Or, is it because the observed lump-sum procedure is not as efficient as it might be? Or, is it because the observed log-scale procedure is more efficient than one might expect?

Most of the results of this study can be picked apart in the same way. The obvious observation is that timber-sale procedures of public agencies have evolved in many directions at the same time. Although each change is made with the objective of more efficient performance, the overall procedure rarely is analyzed to trace the net impact of a change. Thus, manpower might be added or subtracted to accomplish some specific purpose, but the overall impact of the change is often unknown. This suggests that there might be some benefit from comprehensive, systematic analyses of existing timber-sale programs.

REFERENCES


