# Priority-Setting Procedures and Scarce Data: The Synthetic Solution

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**Many public agencies would like to implement a systematic project priority procedure or pavement management system (PMS), but lack the data to do it. This paper presents a way to synthesize the missing data to permit implementation of priority setting or a PMS, in turn providing valuable guidance to the data collection effort. The magnitude of this effort can be minimized if the agency knows which data are of immediate importance. The use of synthetic data makes that knowledge available. A case study is presented to illustrate actual implementation of the synthetic method and to analyze the results. This method is applicable to road and bridge projects, or any ranking procedure that involves multiple criteria and incomplete data.**

There is the presumption on the part of most advocates of highway maintenance priority-setting procedures and pavement management systems (PMS) that the prospective user—be it a city, county, or state—has a comprehensive, up-to-date road network database. But our experience in Indiana indicates that most counties have not made developing and maintaining such a database a high priority. In fact, a recent survey *(1)* determined that only about 15 of Indiana's 92 county road departments had access to computers of the type normally used to store such data. Recently, however, a growing number of counties have expressed an interest in systematizing the selection of road projects for major maintenance and repair. Do these counties have to wait until a complete database is assembled? For some counties, the magnitude of the data collection effort for traffic volumes alone would create interminable delays in implementing a priority-setting system or PMS. As a technology transfer ($T^2$) center project, the author helped develop a set of three simplified county-level, priority-setting techniques having the following principal attributes:

1. They are easy to understand and easy to use.
2. They not only can perform acceptably when a county's database is far from complete, they can be used to direct the county's data collection efforts to minimize use of resources and maximize the quality of the resulting project priorities.

A description of the three simplified methods has appeared in the literature *(2, 3)*. As a sequel to the $T^2$ project, a new data collection effort under way in LaPorte County, Indiana, was monitored and guided in a way that would demonstrate the second attribute listed. In this paper, methods for realizing this attribute and results to date are described.

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## SYNTHETIC DATA

Many factors can be used to characterize the level of need for maintenance or repair activities of a road segment. The most common factors are pavement condition (*PCR*), traffic volume (*ADT*), safety (*HAZ*), and project cost *(2)*. Among these, traffic volume is perhaps the most difficult and time-consuming factor for which to collect data that are accurate enough to use in priority-setting methods.

In LaPorte County, only 90 of 668 road segments had up-to-date traffic volume counts at the start of this study. In the next section, the steps in a procedure to generate synthetic traffic volumes that not only allow the priority-setting methods to be implemented, but also can focus a traffic volume count program on the segments most critical to the priority-setting process are listed. This method can be adapted to the collection of other factor values as well.

### Generating Synthetic Volumes

The steps needed for generating synthetic traffic volumes are as follows:

1. Establish a list of homogeneous road segments (i.e., segments thought to have similar factor values and conditions along their lengths). Subsequent data acquisition may indicate that segments should be subdivided or joined.
2. Identify those segments in the road list that lack up-to-date volume counts. Because these segments must be assigned synthetic volumes, they will be referred to as "synthetic segments" until their actual traffic volumes are determined.
3. Ask one or more knowledgeable persons such as the county road supervisor and his foremen to place each synthetic road into one of three strata—low, medium, or high—based on their perception of the average daily traffic (*ADT*) of each segment. The following *ADT* values have been found useful in defining these volume strata:

$0 < \text{low } ADT < 200$; $200 \leq \text{medium } ADT < 1{,}000$; $\text{high } ADT \geq 1{,}000$

but any number of strata and their boundaries can be adopted. If the knowledgeable persons are considered to have good sense of *ADT* values on synthetic roads, more than three strata can be defined. If subsequent actual counts frequently fail to confirm their judgment, adjacent strata can be combined to provide a wider target. In this paper, a three-stratum case will be assumed.

4. Place each of the actual segments—segments for which actual up-to-data *ADT* values exist—into the appropriate stratum, as defined in Step 3. Once all actual segments are placed in their respective strata, calculate the mean *ADT* value of the actual segments in each stratum: $\bar{v}_{lo}$, $\bar{v}_{med}$, and $\bar{v}_{hi}$.

5. Move those segments not in need of major maintenance or repair to a separate routine maintenance list.

6. Assign all synthetic segments in the low-volume stratum the temporary synthetic *ADT* value of $\bar{v}_{lo}$; assign medium-volume synthetic segments an *ADT* value of $\bar{v}_{med}$ and high-volume synthetic segments an *ADT* value of $\bar{v}_{hi}$.

7. Using these and any other needed synthetic factor values, activate the priority-setting process. Even if a majority of road segments are using borrowed synthetic factor values, there will be sufficient diversity in the combination of factor values (assuming at least three factors) to avoid a large number of ties in the project ranking that results. This will be demonstrated later in the case study example.

8. For those synthetic segments that rank high in the priority list, determine the actual values of their factors as soon as practical. A high rank means the segment would be close enough to the top to be included in the county's work plan, given its budget. This condition can be determined by estimating the project cost for each segment in the priority list, beginning at the top and accumulating project costs until the budget is exceeded by, say, 10 percent.

9. If, for some reason, it is not practical to replace a high-ranking synthetic segment's synthetic values with actual values, the segment's synthetic values will nevertheless be updated as more actual counts are taken and the stratum averages are revised. Before calculating the revised stratum averages, check the new counts to determine if any synthetic segment was placed in the wrong stratum. If so, move the misplaced segment to the proper stratum, based on the boundary values established in Step 3.

10. Repeat Steps 6 to 9 until no synthetic segments appear high in the priority list, or until it is not practical to replace the synthetic factor values of high-ranking synthetic segments with actual data.

This series of steps will probably involve several iterations, so it is especially important to use priority-setting methods that are fast, economical, and flexible. The methods described in the literature *(2, 3)*, one of which is used in the case study example to follow, have these properties.

## A CASE STUDY

The author had the opportunity to test his scheme in a realistic setting. LaPorte County, Indiana, which had just been the subject of a project to develop a simplified road project priority programming procedure *(3)*, was about to embark upon a large-scale traffic volume counting program. The county road supervisor agreed to periodically supply the author with the newly acquired counts and, whenever possible, acquire counts on roads suggested by the author. The rest of this section is a summary of how the synthetic volume count idea was implemented in LaPorte County, structured on the 10 steps listed in the previous section.

### *Step 1: Establish Homogeneous Segments*

A total of 668 such segments were identified, based on a listing supplied by the Indiana Department of Highways, and entered into a datafile.

### *Step 2: Identify the Synthetic Segments*

Of the 668 segments, only 90 had reliable, up-to-date volume counts. This meant there were 578 synthetic segments at the beginning of the study.

### *Step 3: Place Each Synthetic Segment Into a Stratum*

Using the stratum boundaries

$0 <$ low *ADT* $< 200$; $200 \leq$ medium *ADT* $< 1{,}000$;
high *ADT* $\geq 1{,}000$

the county road supervisor and his staff placed 36 of the original 668 segments into the high-volume stratum, 242 into the medium-volume stratum, and 390 into the low-volume stratum.

### *Step 4: Calculate the Synthetic Volume for Each Stratum*

Once the stratum assignments were made, the synthetic volumes

$$\bar{v}_{lo} = 116.26;\ \bar{v}_{med} = 387.69;\ \bar{v}_{hi} = 4{,}027.33$$

were calculated from the mean volume of the actual segments in the corresponding strata.

### *Step 5: Remove Segments in Good Condition From Datafile*

A total of 220 of the 668 segments had *PCR* values of 4 or better and no apparent hazardous conditions, so these segments were moved to a routine maintenance datafile. Of the 448 remaining segments, 374 did not have current volume counts. Some 16 of the 90 segments with current counts were placed on the routine maintenance list, but their actual *ADT* values were still used to calculate synthetic volumes.

### *Step 6: Assign Synthetic Volumes to Synthetic Segments*

One of the $\bar{v}$ values found in Step 4 was assigned to each of the 374 synthetic segments remaining after Step 5, based on the synthetic segment's stratum membership established in Step 3. Until this time, these 374 segments had no *ADT* values associated with them.

### *Step 7: Determine Project Priorities*

Although all three simplified methods developed in the literature *(2, 3)* were used successfully in this step, only the percentile priority-setting technique will be shown in this paper. The top of the output file, containing the top 20 segments in the

TABLE 1 STAGE 0 PROJECT RANKS BY PERCENTILE METHOD

| Rank | Segment No. | *PCR* | *ADT* | *HAZ* | Average Percentage |
|---|---|---|---|---|---|
| 1 | 347. | 1.00 | 672.00 | 1.00 | 97.22 |
| 2 | 283. | 2.00 | 387.69 | 1.00 | 84.38 |
| 3 | 178. | 2.00 | 387.69 | 1.00 | 84.38 |
| 4 | 209. | 1.00 | 4,027.33 | 0. | 77.37 |
| 5 | 276. | 1.00 | 4,027.33 | 0. | 77.37 |
| 6 | 385. | 1.00 | 4,027.33 | 0. | 77.37 |
| 7 | 612. | 1.00 | 4,027.33 | 0. | 77.37 |
| 8 | 155. | 1.00 | 647.00 | 0. | 74.80 |
| 9 | 154. | 1.00 | 387.69 | 0. | 72.75 |
| 10 | 20. | 1.00 | 387.69 | 0. | 72.75 |
| 11 | 34. | 1.00 | 387.69 | 0. | 72.75 |
| 12 | 55. | 1.00 | 387.69 | 0. | 72.75 |
| 13 | 213. | 1.00 | 387.69 | 0. | 72.75 |
| 14 | 232. | 1.00 | 387.69 | 0. | 72.75 |
| 15 | 85. | 1.00 | 387.69 | 0. | 72.75 |
| 16 | 120. | 1.00 | 387.69 | 0. | 72.75 |
| 17 | 331. | 1.00 | 387.69 | 0. | 72.75 |
| 18 | 340. | 1.00 | 387.69 | 0. | 72.75 |
| 19 | 341. | 1.00 | 387.69 | 0. | 72.75 |
| 20 | 345. | 1.00 | 387.69 | 0. | 72.75 |

NOTE: The next 428 segments are not shown in this table.

Segments with *HAZ* = 0 and *PCR* ≥ 4.0 have been moved to routine maintenance list.

| Factor | Input Weight | Norm Weight |
|---|---|---|
| *PCR* | 1.5 | 33.3 |
| *ADT* | 2.0 | 44.4 |
| *HAZ* | 1.0 | 22.2 |
| *COST* | 0. | 0. |

Stage 0 ranking, is shown in Table 1. At this point, there are 24 segments with *PCR* = 1.00 *ADT* (synthetic) = 387.69, and *HAZ* = 0., tying them for ninth position—at least until their synthetic volumes can be replaced with actual counts. There are similar ties throughout this first priority list, but already the relative needs of the county segments have begun to emerge.

### *Step 8: Acquire Actual Counts to Replace Synthetic Volumes on High-Ranking Synthetic Segments*

In a county with over 1,000 mi of roads (over 85 percent of which did not have up-to-date counts), it is useful to know which segment counts will have immediate importance. The road supervisor can weigh this guidance against the desire to avoid placing counters at widely scattered locations throughout the county. The LaPorte County's first volume count update contained 168 new actual segment volumes that affected 8 of the 18 synthetic segments in the top 20 of the first priority list (Table 1).

### *Step 9: Check for Misplaced Segments, Then Update Synthetic Volumes*

The stratum assignments in Step 3 were based on the best available judgment, but 5 of the 168 new actual volumes indicated a need to reassign the segment involved. After the reassignments, the new (Stage 1) synthetic volumes became

$$\bar{v}_{lo} = 115.77;\ \bar{v}_{med} = 447.46;\ \bar{v}_{hi} = 2{,}936.58$$

Thus, even those 10 synthetic segments in the current top 20 that did not get actual volumes for use in the next stage of priority setting will be using updated synthetic volumes.

### *Step 10: Repeat Steps 6–9*

During the course of this study, the county provided 12 sets of volume updates. The most important updates, in terms of size and significance, are presented in Table 2. After four updates, 322 of the county's 668 road segments had received actual volume counts and only one synthetic segment (No. 208) remained in the top 20. If project priority decisions were made at this point, the data in Table 3 or its full 448-segment version would be used as the basis. A total of 7 of the top 20 and 12 of the top 33 segments in Table 1 or its longer version remain that highly ranked in Table 3. This means that some original synthetic volumes were fairly accurate but, more important, even the relatively inaccurate ones provided a focus for the county's volume-counting program. In fact, with at most 50 counts, the county could provide the percentile ranking method with sufficient *ADT* data to produce a list that would not have any synthetic segments.

## AN APPRAISAL OF THE SYNTHETIC SOLUTION

Use of synthetic volumes appears to be an effective way to (a) minimize delays in implementing priority-setting procedures

TABLE 2 TRENDS IN SYNTHETIC VOLUMES

| Stratum: | Low | | | Medium | | | High | | |
|---|---|---|---|---|---|---|---|---|---|
| | $n_k$ | $n_s$ | New Avg. | $n_k$ | $n_s$ | New Avg. | $n_k$ | $n_s$ | New Avg. |
| Stage 0 | 39 | - | 116.26 | 39 | — | 387.69 | 12 | - | 4027.33 |
| Stage 1 | 66 | 0 | 115.77 | 76 | 14 | 447.46 | 26 | 4 | 2936.58 |
| Stage 2 | 77 | 0 | 109.96 | 87 | 10 | 455.76 | 29 | 3 | 2931.10 |
| Stage 3 | 136 | 0 | 94.83 | 138 | 2 | 427.74 | 31 | 0 | 2458.32 |
| Stage 4 | 140 | 0 | 94.17 | 150 | 0 | 428.56 | 32 | 1 | 2515.56 |
| Stage 12 | 267 | 0 | 89..08 | 164 | 0 | 422.45 | 31 | 1 | 2347.32 |

$n_k$ = number of actual segment volumes used to calculate stage k stratum average, which will be used for priority-setting in stage k+1

$n_s$ = number of segments placed in top 20 by percentile method using synthetic volumes ("New Avg.") calculated after the previous stage

Stage 0: Stratum averages based on original 90 "actual segments"

Stages 1-12: Priority-setting done using stratum averages from the results of the previous stage, including counts made since the previous stage

TABLE 3 STAGE 4 PROJECT RANKS BY PERCENTILE METHOD

| Stage 0 Rank | Segment No. | *PCR* | *ADT* | *HAZ* | Average Percentage |
|---|---|---|---|---|---|
| 1 | 347. | 1.00 | 811.00 | 1.00 | 96.03 |
| 114 | 169. | 2.00 | 606.00 | 1.00 | 84.23 |
| 7 | 612. | 1.00 | 4,249.00 | 0. | 77.49 |
| 32 | 348. | 2.00 | 381.00 | 1.00 | 75.69 |
| 10 | 20. | 1.00 | 927.00 | 0. | 74.40 |
| 96 | 163. | 1.00 | 788.00 | 0. | 73.61 |
| 8 | 155. | 1.00 | 782.00 | 0. | 73.51 |
| 9 | 648. | 1.00 | 637.00 | 0. | 72.71 |
| 3 | 178. | 2.00 | 286.00 | 1.00 | 72.64 |
| 103 | 93. | 1.00 | 524.00 | 0. | 72.22 |
| 9 | 154. | 1.00 | 521.00 | 0. | 72.12 |
| 9 | 527. | 1.00 | 444.00 | 0. | 70.73 |
| 2 | 283. | 2.00 | 187.00 | 1.00 | 68.04 |
| 33 | 565. | 2.00 | 5,704.00 | 0. | 66.99 |
| 34 | 42. | 2.00 | 3,312.00 | 0. | 66.69 |
| 34 | 208. | 2.00 | 2,515.25 | 0. | 66.39 |
| 45 | 58. | 2.00 | 2,117.00 | 0. | 65.80 |
| 256 | 148. | 2.00 | 1,501.00 | 0. | 65.30 |
| 9 | 656. | 1.00 | 416.00 | 0. | 65.06 |
| 256 | 620. | 2.00 | 1,404.00 | 0. | 65.00 |

NOTE: The next 428 segments are not shown in this table.

Segments with *HAZ* = 0 and *PCR* ≥ 4.0 have been moved to routine maintenance list.

| Factor | Input Weight | Norm Weight |
|---|---|---|
| *PCR* | 1.5 | 33.3 |
| *ADT* | 2.0 | 44.4 |
| *HAZ* | 1.0 | 22.2 |
| *COST* | 0. | 0. |

and (b) maximize the effectiveness of a volume-counting program. To learn more from the LaPorte County case, some of the elements of the process should be examined.

The volume trends contained in Table 2 are shown in Figure 1. The expectation was that the synthetic volumes would (a) approach the actual stratum averages asymptotically from above or below, or that (b) there might be some straddling of the actual average. Asymptotically from above appears to apply to the high- and low-volume trends, whereas the medium-volume plot may be straddling the eventual actual medium-stratum average. However, not each stage has average-volume calculations based on the same increase in the number of actual segments in a stratum. For example, the update for Stage 3 in Table 2 contained many more segments than for Stage 4, so a bigger change coming into Stage 3 in Figure 1 was expected. However, the overall trends from Stage 0 to Stage 12 were instructive:

- The high-volume stratum average started out 1,680.1 vehicles per day (vpd) higher than its current Stage 12 value, an error of +71.6 percent. By Stage 4, the overestimate was reduced to 168.24 vpd, an error of +7 percent.
- The original medium-volume estimate was 34.76 vpd below its latest value, an error of −8.2 percent. By Stage 4, the estimate was 6.11 vpd (+1.5 percent).
- The first low-volume average was a 27.18-vpd (+30.5 percent) overestimate, when compared to the Stage 12 figures. By Stage 4, the difference was reduced to 5.09 vpd (+5.7 percent).
- By Stage 4, all but one of the high-ranking synthetic segments were converted to segments with actual volume counts.

It is also interesting to note that the original high-volume overestimate with respect to the Stage 12 $\overline{v}_{hi}$, which would have a significant effect on the priority rankings, was reduced from 71.6 to 25 percent after only 14 synthetic high-volume segments received actual counts at Stage 1 (see Table 2). Again, the synthetic solution makes possible efficient use of resources and information of immediate value.

The effectiveness of the synthetic volume method depends to a large extent on the proper assignment of segments to strata in Step 3. Table 4 presents the accuracy with which the synthetic segments were assigned to their correct strata. After Stage 1, 11

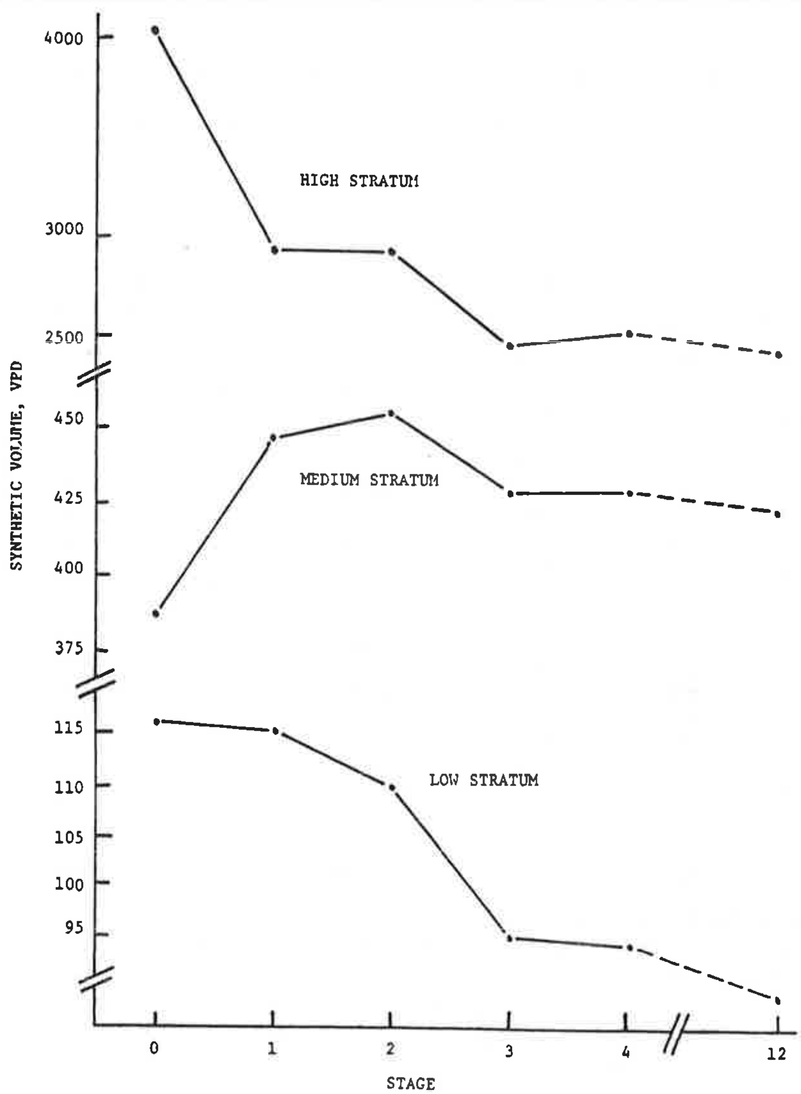


**FIGURE 1 Plot of synthetic volume trends.**

segments thought to belong to the medium stratum had actual counts that caused them to be reassigned to the low stratum. Another 7 medium segments turned out to have high *ADT* values. Out of 78 counts made at Stage 1 in preparation for Stage 2, 29 segments had to be moved. In most cases, these were segments with actual volumes near a stratum boundary. Only rarely to were drastic reassignments (low to high or high to low) necessary, and these were often due to data entry errors. Experience to date indicates no reason to use more than three strata or to revise the stratum boundaries in the case study.

TABLE 4 DEGREE OF ACCURACY IN ASSIGNING SEGMENTS TO STRATA

| | Assigned Stratum | Revised Stratum | | |
|---|---|---|---|---|
| | | High | Medium | Low |
| Stage 0 | High | 36 | 0 | 0 |
| | Medium | 4 | 237 | 1 |
| | Low | 0 | 0 | 390 |
| Stage 1 | High | 39 | 0 | 1 |
| | Medium | 7 | 219 | 11 |
| | Low | 2 | 8 | 381 |
| Stage 2 | High | 43 | 2 | 3 |
| | Medium | 1 | 218 | 8 |
| | Low | 0 | 1 | 392 |
| Stage 3 | High | 34 | 6 | 4 |
| | Medium | 5 | 203 | 13 |
| | Low | 2 | 32 | 369 |
| Stage 4 | High | 39 | 2 | 0 |
| | Medium | 2 | 239 | 0 |
| | Low | 1 | 7 | 378 |
| Stage 12 | High | 38 | 0 | 1 |
| | Medium | 0 | 231 | 5 |
| | Low | 0 | 3 | 390 |

One more way to examine the evolution of the *ADT* datafile from largely synthetic to primarily actual data is through some measure of error that quantifies the relationship between each newly counted segment's actual volume and its most recent synthetic volume. The equation used for each stratum at each stage was

$$D = \sum_{j \in S} (syn_j - act_j)/n \quad (1)$$

where $j$ indicates a segment that has just received an actual volume $act_j$ at Stage $k$; $n$ is the number of such segments; and $syn_j$ is Segment $j$'s (and Stratum $S$'s) most recent synthetic volume. Because $syn_j = syn_S$, Equation 1 was simplified to

$$D = syn_S - (1/n) \sum_{j \in S} act_j \quad (2)$$

and used to produce the entries in Table 5. Because this measure is based only on the segments receiving actual counts at the current stage, and is not cumulative, some volatility might be expected. The low (0–200 vpd) and medium (200–1,000 vpd) strata seem to have well-behaved $D$ values, despite an occasional synthetic segment assigned to the wrong stratum. The high-volume (≥1,000-vpd) stratum has the most room for variation, as is evident in Table 5. At each stage, the synthetic counts are generally much higher than the actual. At Stage 3, there were an unexpectedly high number of segments that were either misassigned (Table 4) or had actual *ADT* values just over 1,000 vpd, which caused the high $D$ value. The $D$ value emphasizes the need to get actual volume counts for any synthetic segments with high preliminary priorities, especially if they are listed as high-volume segments. They are likely to be carrying an overestimated *ADT* and, therefore, too high a ranking. Thus, low $D$ values indicate good judgment in choosing the number of strata and in assigning segments to them. Consistently high $D$ values may indicate the need for more strata with smaller ranges, but as long as high-ranking synthetic segments get actual counts before decisions are made, the impacts of these inaccuracies are negated.

TABLE 5 AVERAGE DIFFERENCE BETWEEN NEW ACTUAL AND PREVIOUS SYNTHETIC VOLUMES

| Stratum | High | Medium | Low |
|---|---|---|---|
| Stage 0 | --- | --- | --- |
| Stage 1 | 2065.97 | -108.08 | -2.09 |
| Stage 2 | 52.91 | -65.63 | 40.68 |
| Stage 3 | 1591.43 | 68.95 | 30.15 |
| Stage 4 | 651.32 | 66.41 | -13.84 |
| Stage 12 | 0 | 174.43 | 37.37 |

NOTE: Negative entry in table means average synthetic volume was lower than average actual volume by that amount. Large entries are usually due to one or more segments having been placed in the wrong stratum.

The most important analysis of the synthetic method takes place using the project ranking lists themselves for successive stages. The synthetic method exploits the facts that most high-ranking synthetic segments have overestimated *ADT* values, and after the first one or two stages it is rare for a holdover synthetic segment to move into the top 20 or 30. Thus, it takes only a few stages (i.e., iterations through Steps 6–9) to develop a reliable database for ranking the most deserving projects, even if data were scarce at the start. In the case study, only three or four stages were necessary.

## THE FINISHING TOUCHES

Throughout the discussion of the case study, the only factor given synthetic values was *ADT*, but in Tables 1 and 3 *COST* is given a weight of zero and is not included in the ranking process. This exclusion is because to expect county officials to maintain ongoing cost estimates for all road segments is unreasonable. Instead, it is wise to wait until the candidates for major roadwork have been identified, such as in Table 3. Then the highest-ranking segments can receive as detailed a cost estimation effort as desired. The decision makers can go down the latest ranked list, approving and skipping projects until the accumulated costs of approved projects are about to exceed the budget. Another approach is to enter these cost values into the priority-setting procedure, assign *COST* an appropriate factor weight, and examine the results. Using 1.0 as the *COST* weight, the percentile method produces the data of Table 6. The priorities are quite similar to those in Table 3, although some high-cost projects including synthetic segment No. 208 slip down a few positions.

This last-minute approach to *COST* values contrasts with the synthetic approach to *ADT* values, but the philosophy is the same: obtain the most useful information for the least effort. It would be possible to develop a synthetic cost function based, for example, on a segment's length, width, *PCR*, *HAZ*, and *ADT* values. If *COST* is believed to be an important factor in sorting out project ranks during the early iterations or stages, the function could provide approximate (synthetic) *COST* values that would be replaced by actual estimates for the top 20 or so segments. The synthetic *COST* value, however, seems much more postponable than does the *ADT* value.

## COMMENTS

This paper has mentioned only road project priorities at the county level, but there is nothing about the synthetic method to prevent its use for bridge project prioritization or by cities. What is important to realize is that the synthetic method does require multiple applications of whatever priority-setting procedure is adopted. Therefore, that procedure had better not be too expensive or inconvenient to run several times over a short period of time. The percentile ranking method used in this paper's case study is one of several that is quick and economical. In the statistical analyses summarized in Tables 2, 4, and 5, the synthetic method is an approximation procedure. On the other hand, the actual case study rankings (Tables 1, 3, and 6) are encouraging in their consistency and logic.

TABLE 6 STAGE 4 PROJECT RANKS WITH COST DATA INCLUDED

| Segment No. | *PCR* | *ADT* | *HAZ* | *COST* | Average Percentage |
|---|---|---|---|---|---|
| 347. | 1.00 | 811.00 | 1.00 | 7.80 | 96.90 |
| 169. | 2.00 | 606.00 | 1.00 | 17.20 | 86.99 |
| 612. | 1.00 | 4,249.00 | 0. | 33.80 | 81.25 |
| 348. | 2.00 | 381.00 | 1.00 | 86.00 | 79.58 |
| 20. | 1.00 | 927.00 | 0. | 83.60 | 78.56 |
| 648. | 1.00 | 637.00 | 0. | 8.40 | 77.78 |
| 155. | 1.00 | 782.00 | 0. | 146.30 | 77.42 |
| 163. | 1.00 | 788.00 | 0. | 761.40 | 77.21 |
| 154. | 1.00 | 521.00 | 0. | 15.20 | 77.17 |
| 93. | 1.00 | 524.00 | 0. | 134.70 | 76.44 |
| 527. | 1.00 | 444.00 | 0. | 93.50 | 75.38 |
| 283. | 2.00 | 187.00 | 1.00 | 62.70 | 73.47 |
| 565. | 2.00 | 5,704.00 | 0. | 690.10 | 71.75 |
| 42. | 2.00 | 3,312.00 | 0. | 154.80 | 71.71 |
| 58. | 2.00 | 2,117.00 | 0. | 92.00 | 71.39 |
| 656. | 1.00 | 416.00 | 0. | 21.00 | 71.34 |
| 148. | 2.00 | 1,501.00 | 0. | 61.90 | 71.22 |
| 603. | 1.00 | 408.00 | 0. | 15.60 | 71.10 |
| 303. | 2.00 | 1,087.00 | 0. | 54.70 | 70.69 |
| 528. | 3.00 | 1,379.00 | 1.00 | 108.70 | 70.27 |

NOTE: The next 428 segments are not shown in this table.

Segments with *HAZ* = 0 and *PCR* ≥ 4.0 have been moved to routine maintenance list.

| Factor | Input Weight | Norm Weight |
|---|---|---|
| *PCR* | 1.5 | 27.3 |
| *ADT* | 2.0 | 36.4 |
| *HAZ* | 1.0 | 18.2 |
| *COST* | 1.0 | 18.2 |

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