Value-Based Pavement Prioritization Tool

Model, Algorithms and Data Sources

# Overview

The value-based pavement model is an algorithm that calculates the benefit/cost ratio of treating pavement in order to spend the paving budget most efficiently by prioritizing pavement where treatment will provide the most benefit. This document describes the model, its algorithms and data sources to support the creation of a value-based pavement prioritization tool.

## Current Solution

Currently, pavement treatment is prioritized using proprietary software, StreetSaver. Priority is based solely on the Pavement Condition Index (PCI) value of each street segment. The pavement group reprioritizes using their knowledge of most used streets.

### Drawbacks of Current Solution

* Reprioritization takes time
* The pavement group does not have data to back up their reprioritization
* StreetSaver defines our paving backlog based solely on PCI value rather than on economic value

## Value-Based Pavement Model Solution

The value-based pavement model provides benefit-cost analysis to prioritize paving treatment based on the cost to travelers on the streets. The lower the PCI value, the more expensive it is to drive on due to wear and tear on the car and increased fuel cost. Therefore, the more vehicles that travel on a road, the greater the cost as the PCI value decreases. The ratio determines at which point in the deterioration curve the benefit of applying treatment outweighs the cost of allowing the pavement to continue deteriorating. When an expensive treatment, such as rebuilding the road, is needed, the model may recommend waiting until the PCI value deteriorates to a certain level in order to gain benefit from the cost of treatment.

### Improvements over Current Solution

* While the pavement group will still reprioritize based on details not included in the value-based model (efficient crew scheduling, excluding segments that will be paved by other budgets/projects), less reprioritization is needed
* The pavement group has data to back up prioritization
* The paving backlog can be defined as a service model, asking for budget to keep the cost of driving below a certain amount

# Solution Output

The value-based pavement model calculates the BC ratio of treating each street segment using a variety of data sources. The data is available to the pavement group as a prioritized list sorted with the highest BC ratio at the top. Treatments that are within budget are at the top and treatments that are out of budget are listed below with a color and/or symbol identifying the difference. The pavement group can override recommended treatment or non-treatment by:

* Flagging segments that will be treated under a separate budget/project, such as a capital improvement project
* Flagging segments that are below the threshold based on budget or BC ratio, but make sense to be paved because of how crews are scheduled

The pavement group can easily see what is in and out of budget and how overrides put them above or below the budget and by how much.

## Fields, Algorithms, and Data Sources

The model requires several inputs including single variables and lookup tables in order to produce the output list that includes all of the information the pavement group needs for additional prioritization. The single variables, lookup tables, and output fields are listed and described below.

### Inputs – Variables

The tool should store (remember the last value used) and in some cases suggest a default value for several variables. The pavement group will need to be able to update the values based on economic changes and in order to run scenarios. The output should list the values of these variables.

| Variable | Default Value | Description and use |
| --- | --- | --- |
| Budget | None | The pavement group needs to be able to enter the allocated budget for the paving program. The modeling tool will use this value to show what is in and out of budget. The pavement group may need to be able to run a few scenarios with different budgets to show leadership what is affected by changing the budget. |
| Discount Rate | 5% | Discount rate is a fascinating financial concept representing the fact that the value of money today is not equivalent to the value of money tomorrow. In the model, the discount rate is a key factor in calculating the future cost of treating or not treating pavement.  Specifically, the variable is used in the NPV formula for the Total PV Benefits output field.  The pavement group should periodically consult an economist to update this value. |
| Car cost per mile | $0.28 | The cost of driving a car 1 mile in city driving conditions, including fuel, maintenance/repair, tires, and depreciation.  The variable is multiplied by traffic volume and by values in the % increase VOC lookup table to calculate the annual increase in Vehicle Operating Cost (VOC). The resulting series of VOC values is then used in the NPV formula to calculate the output Total PV Benefits.  The pavement group should periodically consult an economist to update this value. |
| Bus cost per mile | $1.32 | See Car cost per mile |
| Truck cost per mile | $2.58 | See Car cost per mile |
| Output filename | <yyyymmdd> ValueBasedPrioritization <budget> | Name of the output file, which the pavement group will open in Excel for further analysis and prioritization. |

### Lookup Table Inputs

The following lookup table is needed for various functions in the model. See the appendix for the full table.

|  |  |  |  |
| --- | --- | --- | --- |
| Table name | Description and use | Record count | Field count |
| % increase VOC | Based on the PCI value, by what percent does the vehicle operating cost (VOC) increase over the base cost.  It may be possible to replace this table with calculations, but the model for the table's value changes is currently unknown. | 147 | 5 |

### Main Output List

The output list will include the following fields:

| Field name | Required | Source | Algorithm or Formula | Description and Use | Example |
| --- | --- | --- | --- | --- | --- |
| SEG\_COMPKEY | Optional, but useful | GIS or Hansen | None | Unique ID for the segment to allow for lookup in Hansen, reinput to GIS, and to relate to segment data from other data pulls | 13330 |
| Segment name | Yes | GIS or Hansen | None | Name of the street segment | ROOSEVELT WAY NE BETWEEN NE 55TH ST AND NE 56TH ST |
| RoadName | Optional, but useful | Streetsaver dbo\_RdNames | None | Join dbo\_Section to dboRdnames on RdNames\_Key. Useful for verifying data. | BISHOP PL NW |
| StreetID | Optional, but useful | Streetsaver dbo\_Section | None | Streetsaver ID for the Street. Useful for verifying data in Streetsaver. | CALIFO |
| SectionID | Optional, but useful | Streetsaver dbo\_Section | None | Streetsaver ID for the section of the street. Useful for verifying data in Streetsaver | 020SNN |
| StreetSectionID | Probably useful | Streetsaver dbo\_Section | None | Streetsaver ID for the section of the street. Useful for verifying data in Streetsaver | CORLIW – 010WNN |
| BegLocation | Optional, but useful | Streetsaver dbo\_Section | None | Useful for verifying data. | ES of LINDEN AV N |
| EndLocation | Optional, but useful | Streetsaver dbo\_Section | None | Useful for verifying data. | WS of AURORA AV N |
| SectionLength | Optional, but useful | Streetsaver dbo\_Section | None | Useful for verifying data. | 234 |
| SectionWidth | Optional, but useful | Streetsaver dbo\_Section | None | Useful for verifying data. | 36 |
| Lanes | Optional, but useful | Streetsaver dbo\_Section | None | Useful for verifying data. | 2 |
| FeatureClass | Optional, but useful | Streetsaver dbo\_FCDetail | None | Join dbo\_Section to dbo\_FCDetail on FCDetail\_Key and return Description field | Urban Collector (5) |
| SurfaceType | Optional, but useful | Streetsaver dbo\_SurfaceType | None | Join dbo\_Section to dbo\_SurfaceType on SurfaceType and return Description field | AC/PCC |
| SEGLENGTH | Yes | GIS or Hansen | None | Length of the segment. Used in calculating the cost of driving the segment | 292 |
| ARTDESCRIP | Optional, but useful | GIS or Hansen | None | Identifies the type of arterial. It could be useful to filter by arterial type or analyze the treatment recommendations by type | Principal Arterial |
| TRANDESCRI | Óptional, but useful | GIS or Hansen | None | Identifies the type of transit route. It could be useful to filter by transit type or analyze the treatment recommendations by type | MAJOR TRANSIT ROUTE |
| SURFACEWIDTH | Yes | GIS or Hansen | None | Width of the street segment. Used in verifying treatment cost and segment data | 52 |
| SURFACETYPE | Yes | GIS, Hansen, or StreetSaver | None | Surface type of the street segment. Used to verify treatment options. | AC |
| PVMTCONDIN | Yes | GIS or Hansen | None | Most recent PCI value of the segment. Used in calculating BC ratio | 17 |
| ADT | Yes | GIS: Traffic Count Details layer | ADT value for the Max year for the segment | Average daily traffic on the street segment. Used in calculating BC ratio. Questions: does this data include truck and bus volume – if so, that needs to be subtracted. How is North/South data handled for each segment? | 14,000 |
| Trucks | Yes | SDOT | Volume value for the Max year for the segment; if no data, but truck route, then use a value to be determined | Average daily truck traffic where available from SDOT. Where not available, a value needs to be determined based on truck route type. Used in calculating BC ratio. | 45 |
| Buses | Yes | King County MetroTool (M:\Devapps\MetroTool) | None | Total of the bus routes run on the street segment each day. Used in calculating BC ratio. | 60 |
| Total PV Benefits | Yes | Calculation | Excel's NPV formula:  =NPV(Discount Rate, array of all UntreatedTotalAnnualIncreaseVOC for the segment in the second output table) – NPV(Discount Rate, array of all TreatedTotalAnnualIncreaseVOC for the segment in the second output table)  Long hand: (UntreatedTotalAnnualIncreaseVOC/(1 + Discount Rate)^YearSequence) + (UntreatedTotalAnnualIncreaseVOC/(1 + Discount Rate)^YearSequence) + …. | The difference in vehicle operating cost (VOC) between applying treatment and not applying treatment over the life of the segment.  Used to calculate the B/C Ratio output. | $555,891 |
| Total PV Costs | Yes | Streetsaver: dbo\_NeedsProjection (must use NeedsProjection and not ScenarioProjection since NeedsProjection includes costs and relationship to TreatmentDetail is unknown) | SUM of the following for the segment for all years where the treatment cost is not zero  ((TreatmentCost \* [AreaTreated in Streetsaver]) /(1+discountRate)^yearSequence) | Total cost of applying Streetsaver's selected treatments to the segment.  This value has two purposes:   1. Used to calculate the B/C Ratio output. 2. The running total of this field indicates what is in and out of budget. There should be an indication where the running total of this field (when sorted by B/C ratio in descending order) is above the budget value. | $550,000 |
| B/C Ratio | Yes | Calculation | [Total PV Benefits] / [Total PV Costs] | This is the benefit cost ratio of performing treatment on each segment.  The output list should be sorted by this field in descending order. | 1.2 |

## Second Output List

A second table containing 31 rows per segment—one row per scenario projection year plus PCI values from the previous year—is needed to combine the treatment recommended by Streetsaver per year, projected PCI values (deterioration curve), and calculate the VOC increase per year.

| Field name | Required | Source | Algorithm or Formula | Description and Use | Example |
| --- | --- | --- | --- | --- | --- |
| *One of the unique IDs for the segment* | Yes | GIS or Hansen most likely | None | Identify the Street Segment in order to relate this table to the main output table | *tbd* |
| Segment name | Yes | GIS or Hansen | None | Name of the street segment | ROOSEVELT WAY NE BETWEEN NE 55TH ST AND NE 56TH ST |
| NeedsProjection\_Key | Optional, may be useful | Streetsaver dbo\_NeedsProjection | None | Unique ID for projection record in Streetsaver. Useful for validating results. | 22 |
| StreetID | Optional, may be useful | Streetsaver dbo\_NeedsProjection | None | Useful for validating results. | 000031 |
| SectionID | Optional, may be useful | Streetsaver dbo\_NeedsProjection | None | Useful for validating results. | 010SNE |
| Section\_Key | Optional, may be useful | Streetsaver dbo\_NeedsProjection | None | Useful for validating results. | FF00008B89 |
| ProjectPeriod | Yes | Streetsaver dbo\_NeedsProjection | None | Year of projected PCI values and treatment. Necessary to keep curve in order. Minimum year for each segment is the previous year. | 2019 |
| PCIUntreated | Yes | Streetsaver dbo\_NeedsProjection | None | PCI value if no treatment is applied. For the minimum year for each segment (previous year), this should be the current PCI value. | 10.77594 |
| PCITreated | Yes | Streetsaver dbo\_NeedsProjection | None | PCI value if treatment is applied. For the minimum year for each segment (previous year), this will be 0 and should be treated as Null. | 60.24704 |
| TreatmentDescription\_Key | Optional, but useful | Streetsaver dbo\_NeedsProjection | None | ID for treatment being applied | SYS0000013 |
| TreatmentName | Optional, but useful | Streetsaver dbo\_TreatmentDescription | None | Name of treatment being applied. Join dbo\_NeedsProjection to dbo\_TreatmentDescription on TreatmentDescription\_Key and return Name | DO NOTHING |
| OverlayCode | Optional, but useful | Streetsaver dbo\_Treatment | None | ID for Overlay type. Join dbo\_NeedsProjection to dbo\_TreatementDescription on TreatmentDescription\_Key and return OverlayCode\_Key | SYS0000002 |
| OverlayDescription | Optional, but useful | Streetsaver dbo\_OverlayCode | None | Name for Overlay type. Join dbo\_TreatmentDetail to dbo\_Overlay Code on OverlayCode\_Key and return Description | Do Nothing |
| TreatmentCost | Yes | Streetsaver dbo\_NeedsProjection | None | Cost of applying stated treatment. Used to calculate Total PV Costs in Main Output table | $290.00 |
| AreaTreated | Optional, may be useful | Streetsaver dbo\_NeedsProjection | None | Useful to investigate and validate costs | 277.1111111111 |
| YearSequence | Optional, may be required | Calculation | ProjectPeriod – Current Year (i.e. the year the needs projection is run) | Depending on how NPV can be calculated in Python, this number may be required to calculate Total PV Benefits in the Main Output table. | 25 |
| UntreatedPercentIncreaseVOC\_Car | Yes | Lookup in % increase VOC table | Lookup PCIUntreated in PCI 2 using a close match (if PCIUntreated falls between 2 rows, it should use the next row). Return the corresponding value from the Car column. | Null when YearSequence is 0 or Null.  Based on the PCI value, by what percent does the vehicle operating cost (VOC) increase over the base cost.  Used to calculate UntreatedTotalAnnualIncreaseVOC | 0.301125 |
| UntreatedPercentIncreaseVOC\_Bus | Yes | Lookup in % increase VOC table | Same as Car, but return the Bus column | Same as Car | 0.301125 |
| UntreatedPercentIncreaseVOC\_Truck | Yes | Lookup in % increase VOC table | Same as Car, but return the Truck column | Same as Car | 0.301125 |
| UntreatedTotalAnnualIncreaseVOC | Yes | Calculation | 365 \* (UntreatedPercentIncreaseVOC\_Car \* Car Cost per mile \* ADT + UntreatedPercentIncreaseVOC\_Bus \* Bus Cost per mile \* Buses + UntreatedPercentIncreaseVOC\_Truck \* Truck Cost per mile \* Trucks) \* SegmentLength/5280 | Calculates the total annual increased vehicle operating cost for the segment if it is untreated.  Used to calculate Total PV Benefits. | $1732 |
| TreatedPercentIncreaseVOC\_Car | Yes | Lookup in % increase VOC table | Lookup PCITreated in PCI 2 using a close match (if PCITreated falls between 2 rows, it should use the next row). Return the corresponding value from the Car column. | Null when YearSequence is 0 or Null.  Based on the PCI value, by what percent does the vehicle operating cost (VOC) increase over the base cost.  Used to calculate TreatedTotalAnnualIncreaseVOC | 0.301125 |
| TreatedPercentIncreaseVOC\_Bus | Yes | Lookup in % increase VOC table | Same as Car, but return the Bus column | Same as Car | 0.301125 |
| TreatedPercentIncreaseVOC\_Truck | Yes | Lookup in % increase VOC table | Same as Car, but return the Truck column | Same as Car | 0.301125 |
| TreatedTotalAnnualIncreaseVOC | Yes | Calculation | 365 \* (TreatedPercentIncreaseVOC\_Car \* Car Cost per mile \* ADT + TreatedPercentIncreaseVOC\_Bus \* Bus Cost per mile \* Buses + TreatedPercentIncreaseVOC\_Truck \* Truck Cost per mile \* Trucks) \* SegmentLength/5280 | Calculates the total annual increased vehicle operating cost for the segment if it is Treated.  Used to calculate Total PV Benefits. | $1732 |

## Additional Data

In addition to data for the output, additional tables will be helpful in analyzing the results and effectiveness of the model. These tables are not needed in the initial solution, but will be needed to accomplish 2016 work plan items.

### Tables:

* dbo\_Events and/or dbo\_HistoricalNetworkPCI: Historical PCI data by segment from StreetSaver
* dbo\_FC: Lookup table of Streetsaver segment types (feature classes): Arterial, Collector, Residential, Other. Useful to compare to GIS segment types to possibly explain unexpected deterioration curve differences
* dbo\_FCDetail: More detailed version of previous
* dbo\_MaintenanceHistory: Need to verify validity of this data. Potentially useful to update Hansen 8 work orders and assets. Potentially useful to compare to Historical PCI data for deterioration curve validation. Join to dbo\_Section on Section\_Key
* dbo\_NeedsInitRemainingLife: Potentially useful or even necessary piece of deterioration curve data for model
* dbo\_NeedsRemainingLife: Potentially useful or even necessary piece of deterioration curve data for model
* dbo\_OverlayCode: Combined with dbo\_PCIIncrease, useful in verifying deterioration curves
* dbo\_PCIIncrease: Useful in verifying deterioration curves, particularly in calculating PCI after treatment
* dbo\_TreatmentDetail: Contains cost/square unit, LifeExtension, YearsBetween Seals (140 records. Repeats TreatmentDescriptionKey. CostPerSqUnit can be different for each repeat. Treatment\_Key is unique. Cannot find a way to join Treatment Key to either dbo\_NeedsProjection or dbo\_ScenarioProjection)
* dbo\_TreatmentDescription: Names of treatment types (46 records)
* dbo\_Scenario: Useful information while designing solution. Contains previous scenario names, when run, and what types of streets were filtered for

## Secondary Solution Output

A GIS layer of the above data would provide a value-added solution. The pavement group would be able to enhance their decision analysis by overlaying the BC ratio GIS layer with other layers including RSJI, council districts, planned projects, and any current political or economic mappable concern.

# Appendix

### % increase VOC

Y = % increase  
X = PCI

#### ADT (cars):

y = -0.0027x + 0.3533

#### Trucks:

y = -0.0061x + 0.8028  
R² = 0.9924

#### Buses:

y = -0.0052x + 0.6885  
R² = 0.9932

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| IRR | **PCI 2** | **Car** | **Bus** | **Truck** |
|  | 0 | 0.356923 | 0.693244 | 0.815651 |
| 15.2 | 0.15997 | 0.35575 | 0.691 | 0.813 |
| 15.1 | 0.552136 | 0.352875 | 0.6855 | 0.8065 |
| 15 | 0.944302 | 0.35 | 0.68 | 0.8 |
| 14.9 | 1.336468 | 0.347125 | 0.6745 | 0.7935 |
| 14.8 | 1.728634 | 0.34425 | 0.669 | 0.787 |
| 14.7 | 2.1208 | 0.341375 | 0.6635 | 0.7805 |
| 14.6 | 2.512966 | 0.3385 | 0.658 | 0.774 |
| 14.5 | 2.905133 | 0.335625 | 0.6525 | 0.7675 |
| 14.4 | 3.297299 | 0.33275 | 0.647 | 0.761 |
| 14.3 | 3.689465 | 0.329875 | 0.6415 | 0.7545 |
| 14.2 | 4.081631 | 0.327 | 0.636 | 0.748 |
| 14.1 | 4.473797 | 0.324125 | 0.6305 | 0.7415 |
| 14 | 4.865963 | 0.32125 | 0.625 | 0.735 |
| 13.9 | 5.258129 | 0.318375 | 0.6195 | 0.7285 |
| 13.8 | 5.650296 | 0.3155 | 0.614 | 0.722 |
| 13.7 | 6.042462 | 0.312625 | 0.6085 | 0.7155 |
| 13.6 | 6.434628 | 0.30975 | 0.603 | 0.709 |
| 13.5 | 6.826794 | 0.306875 | 0.5975 | 0.7025 |
| 13.4 | 7.21896 | 0.304 | 0.592 | 0.696 |
| 13.3 | 7.611126 | 0.301125 | 0.5865 | 0.6895 |
| 13.2 | 8.003292 | 0.29825 | 0.581 | 0.683 |
| 13.1 | 8.395459 | 0.295375 | 0.5755 | 0.6765 |
| 13 | 8.787625 | 0.2925 | 0.57 | 0.67 |
| 12.9 | 9.179791 | 0.289625 | 0.5645 | 0.6635 |
| 12.8 | 9.571957 | 0.28675 | 0.559 | 0.657 |
| 12.7 | 9.964123 | 0.283875 | 0.5535 | 0.6505 |
| 12.6 | 10.35629 | 0.281 | 0.548 | 0.644 |
| 12.5 | 10.74846 | 0.278125 | 0.5425 | 0.6375 |
| 12.4 | 11.14062 | 0.27525 | 0.537 | 0.631 |
| 12.3 | 11.53279 | 0.272375 | 0.5315 | 0.6245 |
| 12.2 | 11.92495 | 0.2695 | 0.526 | 0.618 |
| 12.1 | 12.31712 | 0.266625 | 0.5205 | 0.6115 |
| 12 | 12.70929 | 0.26375 | 0.515 | 0.605 |
| 11.9 | 13.10145 | 0.260875 | 0.5095 | 0.5985 |
| 11.8 | 13.49362 | 0.258 | 0.504 | 0.592 |
| 11.7 | 13.88578 | 0.255125 | 0.4985 | 0.5855 |
| 11.6 | 14.27795 | 0.25225 | 0.493 | 0.579 |
| 11.5 | 14.67012 | 0.249375 | 0.4875 | 0.5725 |
| 11.4 | 15.06228 | 0.2465 | 0.482 | 0.566 |
| 11.3 | 15.45445 | 0.243625 | 0.4765 | 0.5595 |
| 11.2 | 15.84662 | 0.24075 | 0.471 | 0.553 |
| 11.1 | 16.23878 | 0.237875 | 0.4655 | 0.5465 |
| 11 | 16.63095 | 0.235 | 0.46 | 0.54 |
| 10.9 | 17.02311 | 0.232125 | 0.4545 | 0.5335 |
| 10.8 | 17.41528 | 0.22925 | 0.449 | 0.527 |
| 10.7 | 17.80745 | 0.226375 | 0.4435 | 0.5205 |
| 10.6 | 18.19961 | 0.2235 | 0.438 | 0.514 |
| 10.5 | 18.59178 | 0.220625 | 0.4325 | 0.5075 |
| 10.4 | 18.98394 | 0.21775 | 0.427 | 0.501 |
| 10.3 | 19.37611 | 0.214875 | 0.4215 | 0.4945 |
| 10.2 | 19.76828 | 0.212 | 0.416 | 0.488 |
| 10.1 | 20.16044 | 0.209125 | 0.4105 | 0.4815 |
| 10 | 20.55261 | 0.20625 | 0.405 | 0.475 |
| 9.9 | 20.94478 | 0.203375 | 0.3995 | 0.4685 |
| 9.8 | 21.33694 | 0.2005 | 0.394 | 0.462 |
| 9.7 | 21.72911 | 0.197625 | 0.3885 | 0.4555 |
| 9.6 | 22.12127 | 0.19475 | 0.383 | 0.449 |
| 9.5 | 22.51344 | 0.191875 | 0.3775 | 0.4425 |
| 9.4 | 22.90561 | 0.189 | 0.372 | 0.436 |
| 9.3 | 23.29777 | 0.186125 | 0.3665 | 0.4295 |
| 9.2 | 23.68994 | 0.18325 | 0.361 | 0.423 |
| 9.1 | 24.0821 | 0.180375 | 0.3555 | 0.4165 |
| 9 | 24.47427 | 0.1775 | 0.35 | 0.41 |
| 8.9 | 24.86644 | 0.174625 | 0.3445 | 0.4035 |
| 8.8 | 25.2586 | 0.17175 | 0.339 | 0.397 |
| 8.7 | 25.65077 | 0.168875 | 0.3335 | 0.3905 |
| 8.6 | 26.04293 | 0.166 | 0.328 | 0.384 |
| 8.5 | 26.4351 | 0.163125 | 0.3225 | 0.3775 |
| 8.4 | 26.82727 | 0.16025 | 0.317 | 0.371 |
| 8.3 | 27.21943 | 0.157375 | 0.3115 | 0.3645 |
| 8.2 | 27.6116 | 0.1545 | 0.306 | 0.358 |
| 8.1 | 28.00377 | 0.151625 | 0.3005 | 0.3515 |
| 8 | 28.39593 | 0.14875 | 0.295 | 0.345 |
| 7.9 | 28.7881 | 0.145875 | 0.2895 | 0.3385 |
| 7.8 | 29.18026 | 0.143 | 0.284 | 0.332 |
| 7.7 | 29.57243 | 0.140125 | 0.2785 | 0.3255 |
| 7.6 | 29.9646 | 0.13725 | 0.273 | 0.319 |
| 7.5 | 30.35676 | 0.134375 | 0.2675 | 0.3125 |
| 7.4 | 30.74893 | 0.1315 | 0.262 | 0.306 |
| 7.3 | 31.14109 | 0.128625 | 0.2565 | 0.2995 |
| 7.2 | 31.53326 | 0.12575 | 0.251 | 0.293 |
| 7.1 | 31.92543 | 0.122875 | 0.2455 | 0.2865 |
| 7 | 32.31759 | 0.12 | 0.24 | 0.28 |
| 6.9 | 32.70976 | 0.117125 | 0.2345 | 0.2735 |
| 6.8 | 33.10193 | 0.11425 | 0.229 | 0.267 |
| 6.7 | 33.49409 | 0.111375 | 0.2235 | 0.2605 |
| 6.6 | 33.88626 | 0.1085 | 0.218 | 0.254 |
| 6.5 | 34.27842 | 0.105625 | 0.2125 | 0.2475 |
| 6.4 | 34.67059 | 0.10275 | 0.207 | 0.241 |
| 6.3 | 35.06276 | 0.099875 | 0.2015 | 0.2345 |
| 6.2 | 35.45492 | 0.097 | 0.196 | 0.228 |
| 6.1 | 35.84709 | 0.094125 | 0.1905 | 0.2215 |
| 6 | 36.23925 | 0.09125 | 0.185 | 0.215 |
| 5.9 | 36.63142 | 0.088375 | 0.1795 | 0.2085 |
| 5.8 | 37.02359 | 0.0855 | 0.174 | 0.202 |
| 5.7 | 37.41575 | 0.082625 | 0.1685 | 0.1955 |
| 5.6 | 37.80792 | 0.07975 | 0.163 | 0.189 |
| 5.5 | 38.20009 | 0.076875 | 0.1575 | 0.1825 |
| 5.4 | 38.59225 | 0.074 | 0.152 | 0.176 |
| 5.3 | 38.98442 | 0.071125 | 0.1465 | 0.1695 |
| 5.2 | 39.37658 | 0.06825 | 0.141 | 0.163 |
| 5.1 | 39.76875 | 0.065375 | 0.1355 | 0.1565 |
| 5 | 40.16092 | 0.0625 | 0.13 | 0.15 |
| 4.9 | 40.55308 | 0.059625 | 0.1245 | 0.1435 |
| 4.8 | 40.95728 | 0.05675 | 0.119 | 0.137 |
| 4.7 | 41.37415 | 0.053875 | 0.1135 | 0.1305 |
| 4.6 | 41.80437 | 0.051 | 0.108 | 0.124 |
| 4.5 | 42.24866 | 0.048125 | 0.1025 | 0.1175 |
| 4.4 | 42.70782 | 0.04525 | 0.097 | 0.111 |
| 4.3 | 43.18271 | 0.042375 | 0.0915 | 0.1045 |
| 4.2 | 43.67423 | 0.0395 | 0.086 | 0.098 |
| 4.1 | 44.1834 | 0.036625 | 0.0805 | 0.0915 |
| 4 | 44.7113 | 0.03375 | 0.075 | 0.085 |
| 3.9 | 45.25912 | 0.030875 | 0.0695 | 0.0785 |
| 3.8 | 45.82814 | 0.028 | 0.064 | 0.072 |
| 3.7 | 46.41979 | 0.025125 | 0.0585 | 0.0655 |
| 3.6 | 47.0356 | 0.02225 | 0.053 | 0.059 |
| 3.5 | 47.67728 | 0.019375 | 0.0475 | 0.0525 |
| 3.4 | 48.3467 | 0.0165 | 0.042 | 0.046 |
| 3.3 | 49.04593 | 0.013625 | 0.0365 | 0.0395 |
| 3.2 | 49.77727 | 0.01075 | 0.031 | 0.033 |
| 3.1 | 50.54326 | 0.007875 | 0.0255 | 0.0265 |
| 3 | 51.34674 | 0.005 | 0.02 | 0.02 |
| 2.9 | 52.1909 | 0.0045 | 0.018 | 0.018 |
| 2.8 | 53.0793 | 0.004 | 0.016 | 0.016 |
| 2.7 | 54.01597 | 0.0035 | 0.014 | 0.014 |
| 2.6 | 55.00549 | 0.003 | 0.012 | 0.012 |
| 2.5 | 56.05302 | 0.0025 | 0.01 | 0.01 |
| 2.4 | 57.16452 | 0.002 | 0.008 | 0.008 |
| 2.3 | 58.34681 | 0.0015 | 0.006 | 0.006 |
| 2.2 | 59.60777 | 0.001 | 0.004 | 0.004 |
| 2.1 | 60.9566 | 0.0005 | 0.002 | 0.002 |
| 2 | 62.40405 | 0 | 0 | 0 |
| 1.9 | 63.96283 | 0 | 0 | 0 |
| 1.8 | 65.64809 | 0 | 0 | 0 |
| 1.7 | 67.47801 | 0 | 0 | 0 |
| 1.6 | 69.47467 | 0 | 0 | 0 |
| 1.5 | 71.6652 | 0 | 0 | 0 |
| 1.4 | 74.08335 | 0 | 0 | 0 |
| 1.3 | 76.77175 | 0 | 0 | 0 |
| 1.2 | 79.78514 | 0 | 0 | 0 |
| 1.1 | 83.19521 | 0 | 0 | 0 |
| 1 | 87.098 | 0 | 0 | 0 |
| 0.9 | 91.62575 | 0 | 0 | 0 |
| 0.8 | 96.96654 | 0 | 0 | 0 |
| 0.750372 | 100 | 0 | 0 | 0 |