Clear Roads Quantifying Econ Value Tool Manual

Purpose

The purpose of this memo is to present how to use the Clear Roads Benefit-Cost Tool (Tool) and the areas to manage in the future to maintain the Tool's functionality. This Tool was built in Excel's Visual Basic Application (VBA) and contains a data entry form that can store user input, make calculations, and load previously entered data. The tool also contains a summary page that allows previously entered data to be compared and a direct cost analysis page that graphs key direct costs year by year for visualization purposes. The main purpose of this tool is to calculate the costs and benefits of winter maintenance procedures based on user input. This memo will first walk through how to use the tool, the different modules within the tool, what each relevant sheet contains and any hidden sheets within the tool.

Overview

This tool acts as a data entry form, database, and calculator for winter maintenance procedures. The tool contains various tables for various categories that will be used in the calculations for the cost and benefit for winter maintenance procedures. The user will enter their specific information into each table category and use the submit button to store that info into its respective database sheet and table. The tool then can conduct a cost benefit analysis and provide relevant information to the user based on the submitted data. On the **Summary Page**, different calculations can be compared, and on the **Direct Cost Analysis** page direct cost information can be graphed year-to-year.

The workbook sheets are:

1.) **Instructions** (Yellow) - Information on how to use the tool and how to update or delete inputs.

2.) **Data Entry Form** (Green) - User inputs values for various categories and calculates results.

3.) **Summary Page** (Purple) - Compare results between different scenarios.

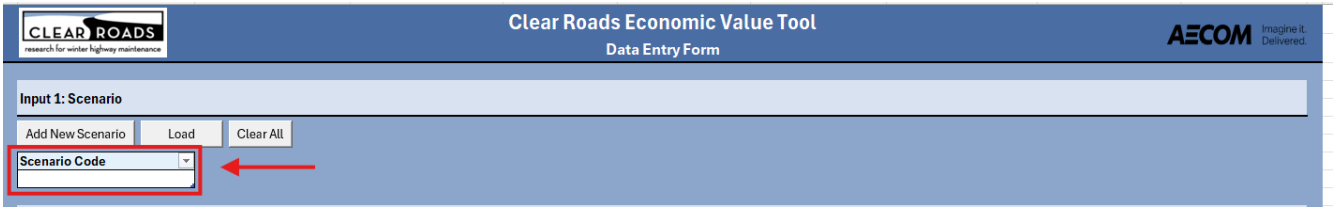
4.) **Direct Cost Analysis** (Light Blue) - Provide inputs related to direct costs to view the maximum, minimum, and visualize yearly trends.

5.) **Database Tables** (Red) – There is a sheet for each data input category. They are stored in separate sheets and can be modified as needed and are all linked by the scenario code.

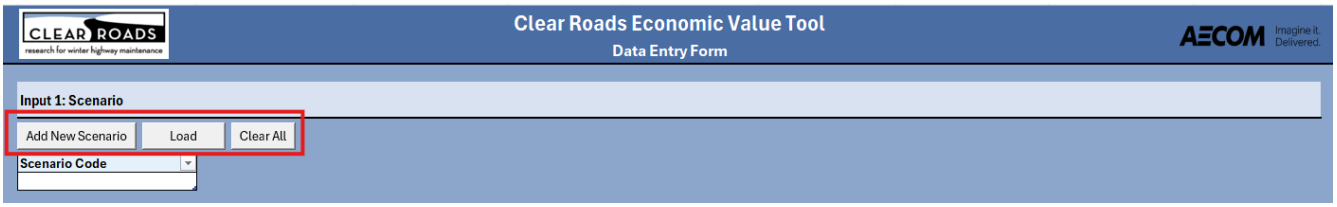
Upon opening the workbook, **be sure to enable Macros** to run the tool.

How to Add Data with Data Entry Form:

Step 1: Add Scenario Code



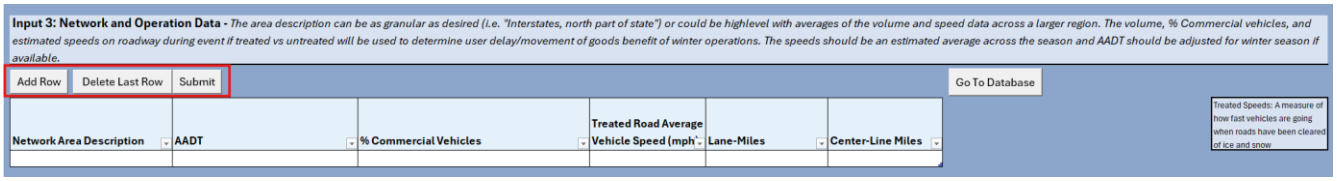
On the second page of the excel file you will find the **Data Entry Form**. This form is where you will input all relevant information that pertains to your specific winter maintenance procedures. The first input you will need to complete is called ***Input 1: Scenario***, where you will need to fill in the scenario code. This scenario code will act as a unique identifier to link all the data in a category, allowing for the final results to be calculated.



The ***Add New Scenario*** button, saves the scenario code that is currently entered into the drop-down list. Now, whenever scenario code is selected, all previously saved scenario codes can be seen and selected from instead of manually entered. The ***Load*** button, fills in all tables with the information that was submitted with the scenario code that is currently entered. This is a quick way to view all the data that has been inputted for a scenario code, as well as what is going into the calculations. Lastly the ***Clear All*** button will clear all the tables on the data entry form and reduce the row sizes to one.

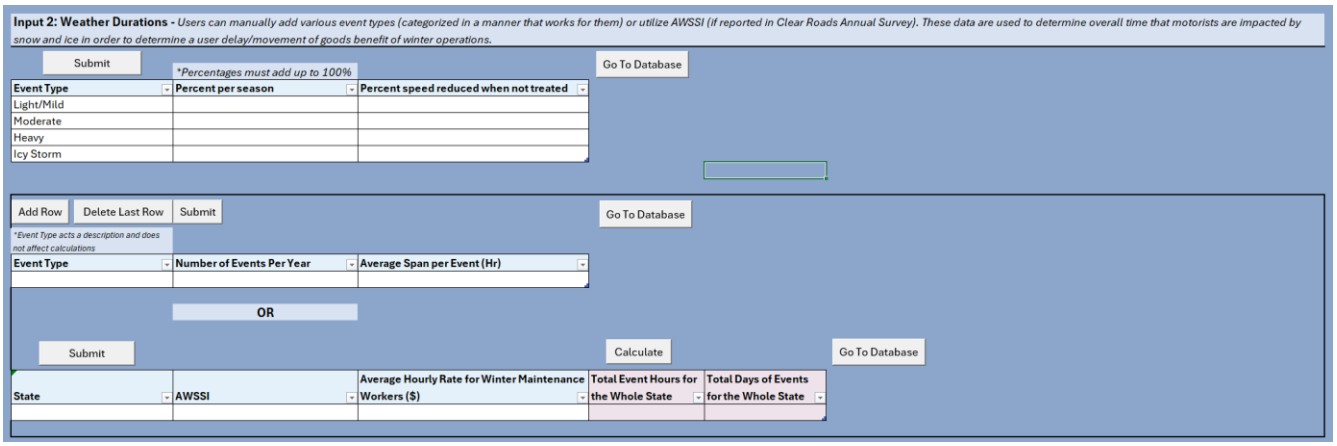
Step 2: Inputs

Regular Inputs:



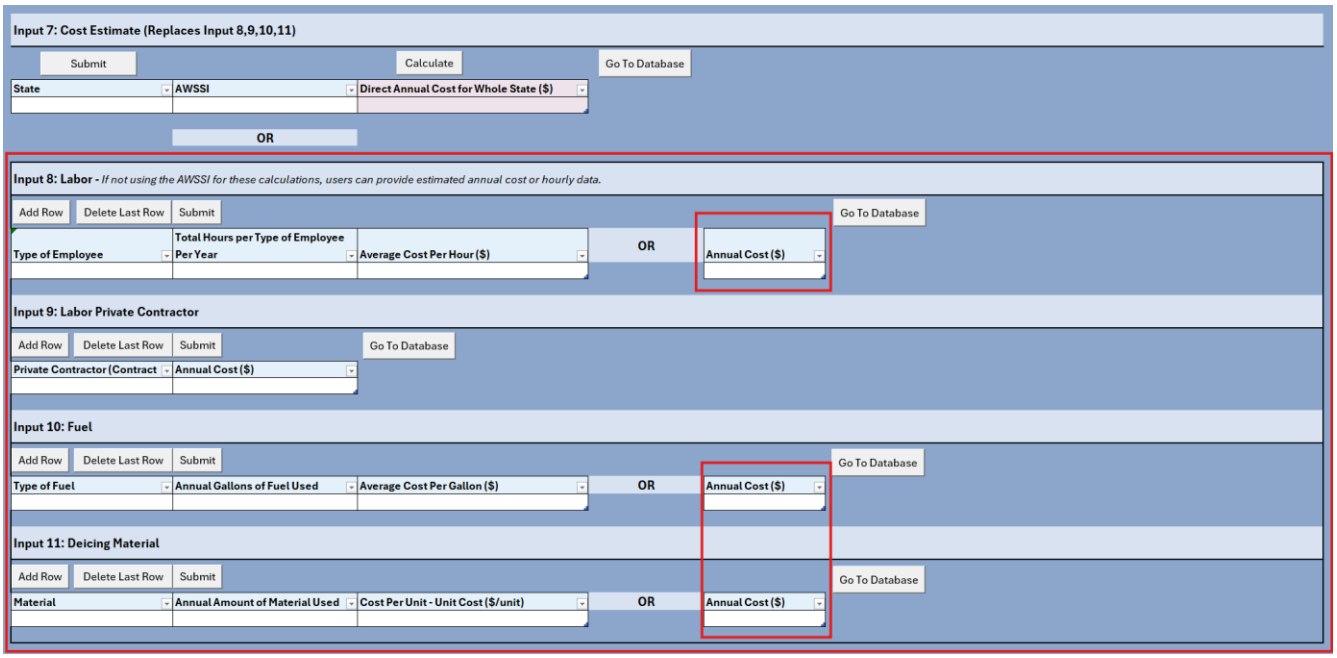
The Add Row button adds an additional row to allow for multiple inputs before submitting. The Delete Last Row button deletes the last row in the table to a minimum of one. Some inputs will not allow the user to add additional rows. This is because when calculating the results of the cost benefit analysis there can only be one input for that category per scenario at a time. The ***Submit*** button saves the data currently entered into the table into the respective database sheet and database table, with the currently entered Scenario Code.

Input Special Case - Weather:



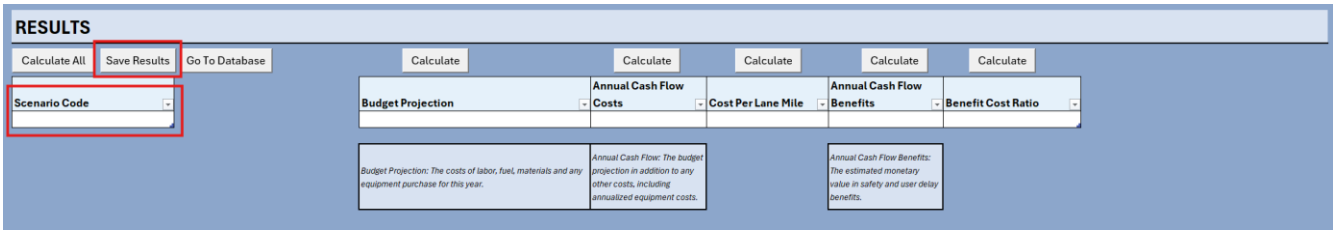
In **Input 2: Weather**, there is an ***OR*** option. The user has a choice to either manually enter in the estimated number of winter events and the average span of those winter events or allow the tool to estimate the total event hours for a specific state based on the AWSSI and average hourly rate for winter maintenance workers using the calculated button. If the estimated total event hours are submitted for a scenario code it will use that value in calculations even if values have been submitted for the other table, since this estimates annual event hours for the whole state. Only one estimated annual event hours for the state can be submitted per scenario code. However, the percentages for each event type above the two tables must be filled in.

Input Special Case – 7,8,9,10,11



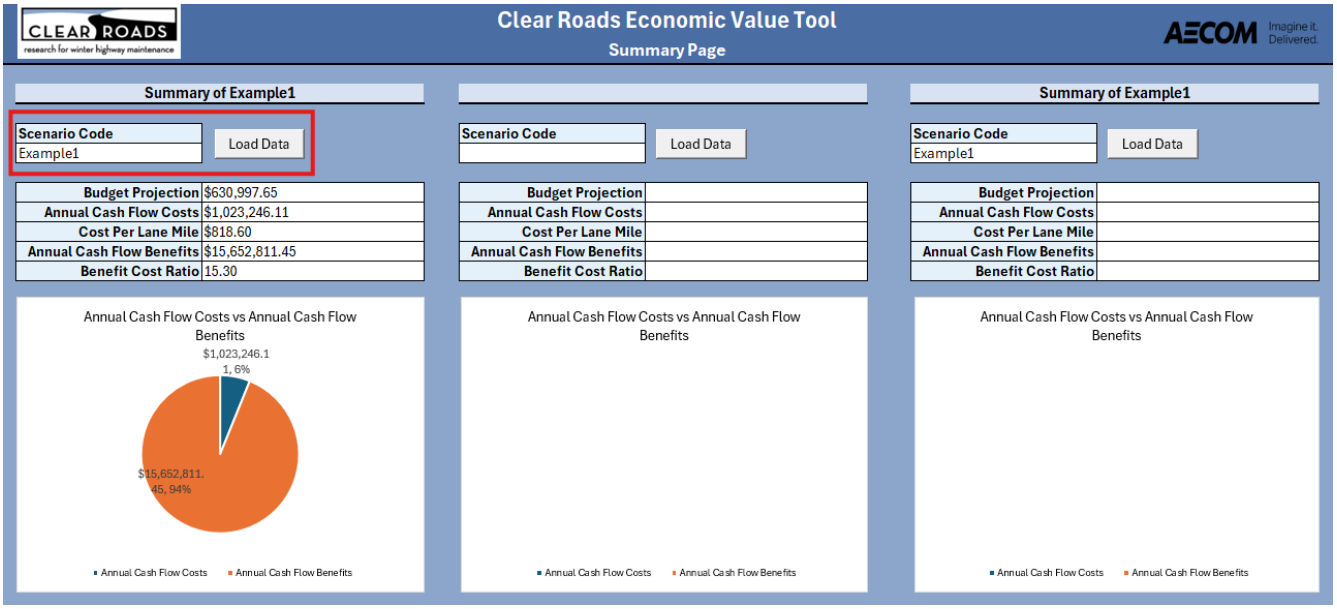
The user may choose to use **Input 7** to estimate the direct annual costs for the whole state for the year, based on the state and AWSSI, or manually input direct cost information for **Input 8,9,10,11**. If the user chooses to manually input direct cost information, then the Annual Cost can be inputted directly in the right most table instead of using the leftmost table or if this is not known it can be calculated based on specific information related to the amount and cost in the leftmost table. There can only be one estimate for direct annual costs per scenario code, and if the user chooses to manually input direct costs in the Annual Cost table, then it will override any values that would have been calculated in the leftmost table.

Step 3: Calculate Results



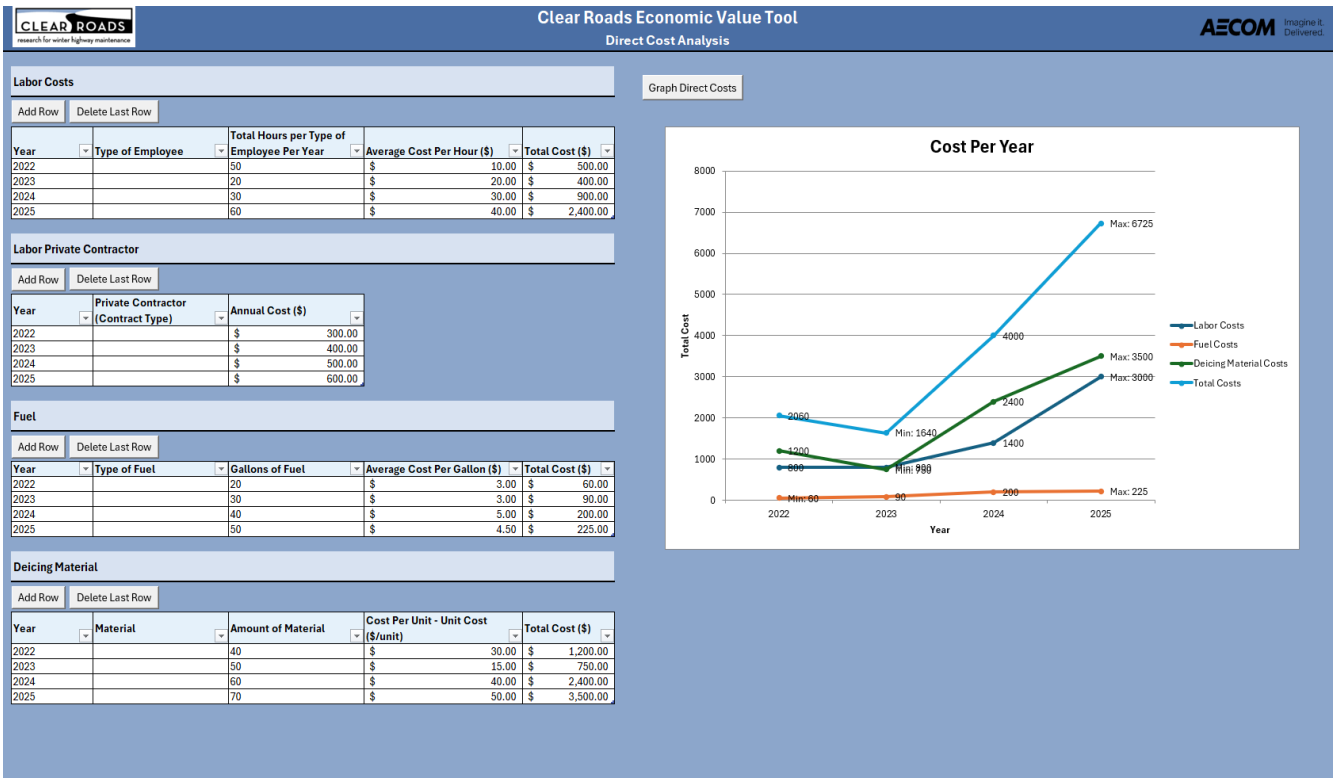
After all the data entry form has been filled out and submitted with a scenario code. The results of the cost benefit of analysis can be calculated and outputted to the table shown above. First a scenario code must be typed into the table which contains a dropdown of previously saved scenario codes. Then the ***Calculate All*** or separate ***Calculate*** buttons may be used to calculate different parts of the cost benefit analysis. These results can then be saved to the Results sheet by using the ***Save Results*** button.

How to Use Summary Page:



The **Summary Page** allows the user to compare saved results of up to 3 scenario codes. By inputting a scenario code and pressing the ***Load Data*** button, the saved results will be formatted into the table shown and create a pie chart showing the benefit to costs.

How to Use Direct Cost Analysis Page:

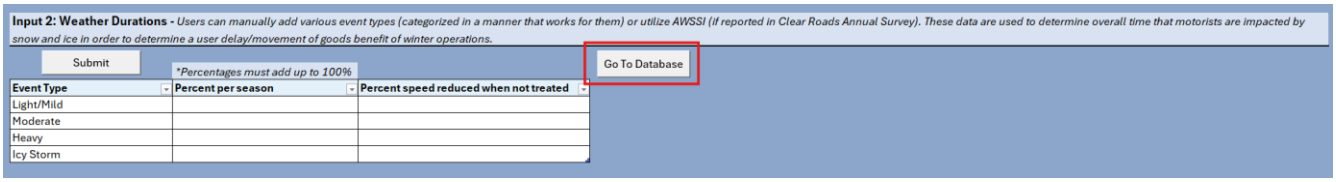


The **Direct Cost Analysis Page** allows the user to input direct costs in tables like the data entry form. Rows can be added and deleted but will require a year input at the beginning of each row. The ***Graph Direct Costs*** button will create a line graph

for each of the categories in separate colors with the year as the X-axis and the Total Cost as the Y-axis. The minimum and maximum will also be labeled on the graph.

How to Remove/Modify Submitted Data:

Whenever the ***Submit*** button is used, any data with a matching scenario code will be overwritten with the current data that is being submitted. This allows the user to edit data for each scenario code by first using the ***Load*** button to bring in previously entered data, making edits to it, and submitting it once again.



To remove data entirely without overwriting it, use the ***Go To Database*** button and this will bring the user to the database sheet for the specific table the button is next to. Here the user can right click any row and delete them from the table entirely, or modify the table.

Tool Maintenance

This section goes through the backend of the tool for future maintenance.

Modules in Tool:

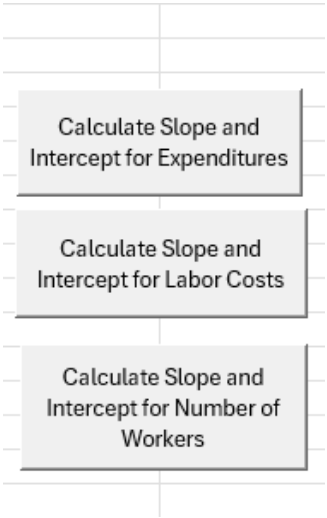
Modules	Subs	Description	Sheets Utilizing Command
Module 1	Sub GoToSheet(SheetName)()	Bring the user to the database sheet for a table. This macro is repeated through the data entry form.	Data Entry Form
Module 1	LoadScenarioData()	Loads previously submitted data onto the data entry form from the various database sheets based on the scenario code that is currently inputted.	Data Entry Form
Module 1	AddRowToTable(tableName As String)	Helper function for LoadScenarioData()	Data Entry Form
Module 1	DeleteLastRowFromTable(tableName As String)	Helper function for LoadScenarioData()	Data Entry Form
Module 1	AddScenarioCodeToDropdown()	Saves the current inputted scenario code to the dropdown list.	Data Entry Form
Module 1	ClearAllTables()	Clear all data inputted in the tables on the Data Entry Sheet and reduces row sizes to one.	Data Entry Form
Module 1	Submit(***TableName***)TableData()	Submits the data currently entered into the specific category table on the data entry form, to the correct database sheet table. This macro is repeated throughout the data entry form.	Data Entry Form
Module 1	AddRowTo(***TableName***)Table()	Adds row to specified table. This macro is repeated throughout the data entry form and the direct cost analysis sheets.	Data Entry Form, Direct Cost Analysis
Module 1	DeleteLastRowFromDelayTable()	Deletes the last row from the specified table down to a minimum of one. This macro is repeated throughout the data entry form and the direct cost analysis sheets.	Data Entry Form, Direct Cost Analysis
Module 2	CalculateAll()	Performs the following macros:	Data Entry Form

		CalculateBudgetProjection() CalculateAnnualCashFlowCosts(), CalculateCostPerLaneMile(), CalculateAnnualCashFlowBenefits() CalculateBenefitCostRatio().	
Module 2	CalculateBudgetProjection()	Calculates the direct costs based on matching scenario code data.	Data Entry Form
Module 2	CalculateAnnualCashFlowCosts	Calculates total annual costs based on matching scenario code data.	Data Entry Form
Module 2	CalculateCostPerLaneMile()	Calculates the cost per lane mile based on matching scenario code data.	Data Entry Form
Module 2	CalculateAnnualCashFlowBenefits()	Calculates annual cash flow of benefits based on matching scenario code data.	Data Entry Form
Module 2	CalculateBenefitCostRatio	Calculates the benefit to cost ratio based on the total annual costs and the annual cash flow benefits.	Data Entry Form
Module 2	SaveResults()	Saves the results in the results table to the results sheet and table with the inputted scenario code.	Data Entry Form
Module 3	CalculateExpenditures	Peforms linear regression on the StateDataTable to calculate the slope and intercept for each state based on AWSSI and Expenditures.	State Data
Module 3	CalculateLaborCosts()	Peforms linear regression on the StateDataTable to calculate the slope and intercept for each state based on AWSSI and Labor Costs.	State Data
Module 3	CalculateWorkers	Peforms linear regression on the StateDataTable to calculate the slope and intercept for each state based on AWSSI and number of workers.	State Data
Module 5	CalculateEstimatedExpenditures()	Calculates the annual direct costs for the whole state with user inputted AWSSI using the slope intercept formula and the matching state slope and intercept for expenditures.	Data Entry Form
Module 5	CalculateLaborCostAndWorkers()	Calculates the total event hours for the whole state with user inputted AWSSI and average hourly rate using the slope intercept formula and the matching state slope and intercept for number of workers and labor costs.	Data Entry Form
Module 4	CreateCostPerYearGraph()	Plots Cost Per Year graph based on user input in each category for direct costs.	Direct Cost Analysis
Module 4	Sub LabelMinMax(series As series, data As Object)	Helper function for CreateCostPerYearGraph() to label the min and max on the graph.	Direct Cost Analysis
Module 4	CopyScenarioResults()	Loads the saved results based on the input scenario code into the correct cells. This macro is repeated in the Summary Page.	Summary Page

Updating State Data For Estimations

State	Year	AWSSI	Expenditures	Labor Cost	Workers	Labor (In House)	Labor (Private)
Alabama	2022	34					
Alaska	2022	2,527		$ 13,633,838	553	480	73
Arizona	2022	416	$ 13,799,159	$ 4,326,025	520	520	0
Arkansas	2022	94			0		
California	2022	421	$ 170,344,209	$ 77,450,659	2545	1,945	600
Colorado	2022	780	$ 113,339,226	$ 35,275,715	1488	1,408	80
Connecticut	2022	368	$ 16,979,218	$ 9,217,971	1380	1,380	0
Delaware	2022	86	$ 602,684	$ 211,707	452	404	48
District of Columbia	2022	47			0		
Florida	2022	6			0		
Georgia	2022	23	$ 10,737,042	$ 3,393,463	1922	1,922	0
Hawaii	2022				0		
Idaho	2022	1,006	$ 30,022,351	$ 5,760,787	571	551	20
Illinois	2022	327	$ 78,651,767	$ 22,502,567	3116	1,690	1,426
Indiana	2022	290	$ 35,726,079	$ 4,125,549	1858	1,753	105
Iowa	2022	653			1494	1,069	425
Kansas	2022	388	$ 14,582,000	$ 5,868,000	1130	1,100	30
Kentucky	2022	119	$ 45,968,551	$ 10,252,827	1800	1,800	0
Louisiana	2022	24			0		
Maine	2022	1,408	$ 47,800,000	$ 17,800,000	745	745	0
Maryland	2022	88	$ 35,755,531	$ 11,401,341	780	750	30
Massachusetts	2022	244	$ 92,571,000	$ 9,380,000	1200	400	800
Michigan	2022	1,080	$ 108,969,258		519	410	109
Minnesota	2022	1,646	$ 173,953,000	$ 59,777,671	1756	1,663	93
Mississippi	2022	49			0		
Missouri	2022	224	$ 31,747,628	$ 11,330,492	2597	2,180	417
Montana	2022	1,368	$ 35,347,362	$ 12,881,984	729	565	164
Nebraska	2022	726	$ 37,420,000	$ 12,004,000	833	783	50
Nevada	2022	801	$ 22,055,582	$ 7,703,521	434	431	3
New Hampshire	2022	916	$ 54,044,136	$ 20,417,422	680	680	0

On the **State Data** sheet there is a table that contains data related to reported data on a state's direct cost expenditures that comprises labor, materials, and fuel. It also contains how many workers that were hired by the state both in-house and private, organized by year from 2014 to 2023. When calculating annual direct costs and annual winter event hours the estimations may not be available for states without reported data or may be more accurate for some states due to a higher volume of reported data.



State	Slope	Intercept
Alabama	60043.70328	207592.5276
Arizona	29755.08477	1448996.121
Arkansas (Negative Slope)	-8225.033113	16211679.07
California	406461.2216	0
Colorado	197634.6588	0
Connecticut	35182.31643	11558128.57
Delaware	65647.99635	0
Georgia	93552.12389	6743641.664
Idaho	22824.97256	4383171.595
Illinois	83975.73718	44309906.22
Indiana	30263.11846	23536668.79
Iowa	19411.94923	21210644.52
Kansas	44966.16365	387254.4408
Kentucky	145480.2165	22287819.7
Maine	4525.832448	32436227.41
Maryland	373703.3178	8666139.438
Massachusetts	100438.6118	51333123.02
Michigan	25713.56137	72329505.79
Minnesota	71321.1531	21374452.23
Missouri	122972.8124	7510280.647
Montana	14256.90842	11965457.72
Nebraska	45903.78133	2773240.519
Nevada	26897.67141	1084779.661
New Hampshire	3657.827512	43220221.85
New Jersey	336850.0774	0
New Mexico	196363.6364	0
New York (Negative Slope)	-94514.44797	437959228.7
North Dakota	13809.99597	3044160.037
Ohio	107525.5911	58960082.37
Oregon	24020.22805	22475489.07
Pennsylvania	169914.3872	178338908.5
Rhode Island	2114.638237	10254739.08
South Carolina	30895.04945	1548538.471
South Dakota	23613.78457	0
Tennessee	56563.15054	14580691.79
Texas	389318.5847	0
Utah	20969.20301	15560860.28
Vermont	20072.94586	10923936.86
Virginia	1654843.976	0
Washington	34548.15769	36332935.67
West Virginia	133519.518	0
Wisconsin	49391.53774	37763033.74
Wyoming	22752.63923	5084072.024

State	Slope (Labor Costs)	Intercept (Labor Costs)
Alabama	27697.8206	0
Alaska (Negative Slope)	-48312.67895	135719977.7
Arizona	10039.43905	196081.2436
California	177978.9652	0
Colorado	59113.29953	0
Connecticut	20891.01958	4490639.444
Delaware	14862.10966	0
Georgia	12994.15428	2816096.618
Idaho	4566.077087	632411.3603
Illinois	26666.66484	13251001.26
Indiana	10760.42487	326851.5219
Iowa	4514.688911	10554508.2
Kansas	15205.32548	968355.3258
Kentucky	40225.96438	4790008.229
Maine	452.9962885	13348897.1
Maryland	77546.58996	6690477.649
Massachusetts	9534.996779	6145696.636
Minnesota	15230.91559	13473076.08
Missouri	64082.66586	113642.392
Montana	7016.320663	2367182.547
Nebraska	18084.68966	0
Nevada	10376.55886	0
New Hampshire	124.2956775	15713402.05
New Jersey	58646.61654	0
New York (Negative Slope)	-84735.64929	268295748
North Dakota	5811.820013	1431118.963
Ohio	2680.606715	26704648.94
Oregon	8255.297948	9554665.474
Pennsylvania	57560.67681	83855644.24
Rhode Island (Negative Slope)	-740.4978528	1544751.796
South Carolina	15100.53077	521845.841
South Dakota	6051.3156	0
Tennessee	17510.62313	4529467.305
Texas	215986.5326	0
Utah (Negative Slope)	-7913.673072	12828751.59
Vermont	1482.763221	10093109.72
Virginia	38312.12122	19142081.33
Washington	10850.20631	15349351.07
West Virginia	41302.46969	2579661.674
Wisconsin	12940.33039	11142744.3
Wyoming	17349.69414	0

State	Slope (Workers)	Intercept (Workers)
Alabama	-12.16727861	1190.746538
Alaska	0.005834662	157.8823569
Arizona	0.173613051	442.6901596
Arkansas	3.881678666	0
California	0.316047664	3698.832199
Colorado	-1.483245433	2623.680225
Connectic	-0.231847532	1480.710305
Delaware	-1.177387412	583.767947
District of	0	0
Florida	0	0
Georgia	-7.196598944	1222.373904
Idaho	0.199743499	340.50751
Illinois	-2.588812421	4203.793709
Indiana	-1.678568559	2069.559679
Iowa	0.206707104	1376.862915
Kansas	-2.285934881	1936.259979
Kentucky	-1.293657782	1233.991237
Louisiana	2.818391767	19.93091822
Maine	0.091605766	773.5028353
Maryland	-3.63456893	1359.505815
Massachu	-0.449721728	1180.390575
Michigan	-0.046229287	500.4002652
Minnesot	2.08613356	0
Mississip	-0.498331814	51.25421522
Missouri	0.974283215	2736.563998
Montana	-0.016853494	744.7437564
Nebraska	0.014555081	962.8218757
Nevada	-0.356332349	527.3455124
New Hamp	-0.003322932	675.4337268
New Jerse	0.254263789	303.125706
New Mexic	-3.629304962	1104.592504
New York	0.569782851	3075.154333
North Car	0	0
North Dak	-0.000423379	366.9926164
Ohio	0.530981069	2762.024526
Oklahoma	-2.472373837	536.9400411
Oregon	0.392567478	916.265499
Pennsylva	0.887343125	4398.183934
Rhode Isla	-0.015179606	158.2180722
South Car	-8.665773911	1606.199486
South Dak	0.018707771	395.7383864
Tennessee	5.885177085	0
Texas	21.47685731	2047.190804
Utah	0.842932731	209.2083265
Vermont	0.013163087	320.5886769
Virginia	0.450859969	746.4551569
Washingt	0.253030799	1217.669557
West Virgi	-0.045266868	4655.297742
Wisconsir	0	0
Wyoming	0.951558184	0

Using the ***Calculate Slope and Intercept*** buttons, the slopes and intercepts can be generated through linear regression and the data in the previously mentioned table. The current slopes and intercepts for the tool have already been generated. States with a negative slope and states with no data will not have predictive analytics available. However, if data is directly added to the table in the same format provided the ***Calculate Slope and Intercept*** can be used to generate a new set of slopes and intercepts. These buttons can also be used to generate a new set if data for more recent years are added as well.

Hidden Sheet

There are two hidden sheets within the tool. One contains the data used for linear regression called **State Data** which was previously mentioned. The other sheet called **Dropdowns** contains all the dropdowns used in the Tool. To unhide either of the tabs, simply right-click any of the tabs and click “Unhide…”, select the “Dropdown” or “State Data” tab from the panel, and press “OK”. The hidden list tab will appear at the very end of the sheet list. In the Dropdown tab, there are some values linked to some dropdown lists in the tool.