



Solver

WV Mining Problem

Topics

- Use Solver
- Specify constraints for Solver

Background Information

This project includes information on coal mining in West Virginia from 1994 to 2014.

Instructions

IMPORTANT: Complete the steps below in the order they are given. Completing the steps out of order may complicate the assignment or result in an incorrect result.

1. Download and extract the provided Data Files ZIP file. It contains the following files for use in this assignment:
 - a. **mining_pps_wvmp.xlsx** – Information on coal mining in West Virginia [1], [2].

Sheet: <i>Coal Mined</i>		
Column Name	Type	Description
County	Text	Name of the West Virginia county.
Region	Text	Region where the county is located.
1994	Number	Tons of coal mined in the county in 1994.
1999	Number	Tons of coal mined in the county in 1999.
2004	Number	Tons of coal mined in the county in 2004.
2009	Number	Tons of coal mined in the county in 2009.
2014	Number	Tons of coal mined in the county in 2014.
Pctg of Total Mined	Percentage	Percentage of all coal mined in 2014 that was mined in the county.
2014 Top 10 County	Text	Indication if the county ranked in the top 10 for coal mined in 2014.
1994+ Top 10 County	Text	Indication if the county ranked in the top 10 for coal mined any time 1994 or later.



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Sheet: <i>Prices</i>		
Column Name	Type	Description
County	Text	Name of the West Virginia county.
Region	Text	Region where the county is located.
1994	Currency	Per-ton price of coal sold in 1994.
1999	Currency	Per-ton price of coal sold in 1999.
2004	Currency	Per-ton price of coal sold in 2004.
2009	Currency	Per-ton price of coal sold in 2009.
2014	Currency	Per-ton price of coal sold in 2014.
Average Price	Currency	Average of coal prices during the period 1994-2014.
Inflation-Adjusted 1994	Currency	1994 coal price adjusted for inflation to 2014.
2014 Rank	Number	Rank of coal prices in 2014.
2014 Rank Class	Text	Indication of the county's coal prices are in the top, middle, or bottom third.
Coal Pricing	Text	Relative indication of coal prices in 2014.

Sheet: <i>Total Values</i>		
Column Name	Type	Description
County	Text	Name of the West Virginia county.
Region	Text	Region where the county is located.
1994	Currency	Total value of coal mined in 1994.
1999	Currency	Total value of coal mined in 1999.
2004	Currency	Total value of coal mined in 2004.
2009	Currency	Total value of coal mined in 2009.
2014	Currency	Total value of coal mined in 2014.
Coal Pricing	Text	Relative indication of coal prices in 2014.
2009-2014 Change	Text	Indication if the total value increased between 2009 and 2014.
Sparkline	Sparkline	Empty column.
County (Region)	Text	Region and county names.



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Sheet: <i>Forecasts</i>		
Column Name	Type	Description
Region	Text	Region where the county is located.
1994 Tons	Number	Tons of coal mined in the region in 1994.
1999 Tons	Number	Tons of coal mined in the region in 1999.
2004 Tons	Number	Tons of coal mined in the region in 2004.
2009 Tons	Number	Tons of coal mined in the region in 2009.
2014 Tons	Number	Tons of coal mined in the region in 2014.
2019 Tons	Number	Forecasted tons of coal mined in the region in 2019.
2019 Price	Currency	Forecasted per-ton price of coal in 2019.
2019 Total Coal Value	Currency	Forecasted total value of coal mined in 2019.

Sheet: <i>Analysis Questions</i>		
Column Name	Type	Description
Question Number	Text	Question being answered.
Response	Text	Response to the analysis question prompt.

- Open the **mining_pps_wvmp.xlsx** workbook in Microsoft Excel.

Use Solver

- We want to use the Solver add-in to explore different mining scenarios on the *Forecasts* sheet.
 - We want to find the growth rate that results in 164,200,572 tons of coal mined in 2019 in cell **G16**. Have Solver change the value of cell **B4** until it locates the correct value. Use the **Simplex LP** solving method.

Specify constraints for Solver

- Coal prices vary by region. We want to find where we can mine coal to minimize the total value of coal in cell **I16**. Have Solver change the values of cells **G6** through **G15** until it locates the correct values. Use the **Simplex LP** solving method.

Set a constraint that the value of **G16** must equal 164,200,572.



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- c. We wish to ensure that additional mining takes place in the region with the lowest coal prices while using all existing mine capacity. We want to minimize the total value of coal in cell **I16**. Have Solver change the values of cells **G6** through **G15** until it locates the correct values. Use the **Simplex LP** solving method.

Set a constraint that the value of **G16** must equal 164,200,572. Set an additional constraint that the values in cells **G6** through **G15** must be greater than or equal to the values in cells **F6** through **F15** to ensure that all existing mine capacity will continue to be used.

4. Starting in row **2** of the *Analysis Questions* sheet, answer the analysis question below. Respond to one question per row.
- a. Steam coal is cheaper in North Central West Virginia than in other parts of the state. If it is cheaper in this region, what are two possible reasons for continuing to mine steam coal in other regions?

Grading Rubric

This assignment is worth 8 points. It will be graded by your instructor using this rubric:

Standard	Meets Requirements (8 points)	Does Not Meet Requirements (0 points)
Student made reasonable effort in correctly completing assignment.	Assignment is at least 70% complete and correct, or student contacted instructor for help on incorrect or incomplete items.	Assignment is less than 70% complete and correct, and student did not contact instructor for assistance on incorrect or incomplete items.

This rubric will be used for peer evaluation of this assignment:

Standard	Excellent	Satisfactory	Needs Improvement
Assignment is correct and complete.	Assignment is at least 90% complete and correct.	Assignment is 70%-89% complete and correct.	Assignment is less than 70% complete and correct.



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The analysis question in Step 4a will be evaluated using this rubric:

Standard	Meets Requirements	Does Not Meet Requirements
Answer is reasonable.	Answer addresses the question prompt and is factually correct or a reasonable interpretation of available data.	Answer does not address the question prompt, is factually incorrect, or is an unreasonable interpretation of available data.
Answer is supported.	Logical rationale is provided to support the given answer.	Logical rationale is not provided to support the given answer.

References

- [1] "West Virginia Mining Statistics," *West Virginia Office of Miners' Health, Safety and Training*, Apr. 14, 2016. Available: <http://www.wvminesafety.org/STATS.HTM>.
- [2] "Annual Coal Report," *Energy Information Administration*, Mar. 23, 2016. Available: <http://www.eia.gov/coal/annual/>.