

Lab06-CPLEX

Exercises for Algorithms by Xiaofeng Gao, 2018 Spring Semester.

* If there is any problem, please contact TA Jiayi Liu (jszljx@163.com).

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A subway company has been awarded the contract to operate a subway in Shanghai. The Traffic Planning Department has estimated that at least the following number of staff is needed each four-hour interval throughout a standard 24-hour period:

Time Period	06-10	10-14	14-18	18-22	22-02	02-06
Staff	700	200	800	300	100	100

All staff works in continuous 8-hour shifts. There are six possible shifts that start on the hour in the beginning of each 4-hour period in the table. All staff has the same hourly salary, except that the hourly salary is 50% higher between 20.00 and 24.00. Moreover, the hourly salary is 100% higher between 24.00 and 6.00.

1. Find how many employees are needed for each of the six shifts in order to minimize the salary costs for the company, while at the same time satisfying the staffing requirements. Describe your model in *OPL* and use CPLEX Optimization Studio to solve this problem. Remember to use a separate data file (.dat) rather than embedding the data into the model file (.mod).
2. The company is considering to double the number of tours between 10 and 14. For this, they would need 400 workers for this shift. Run the resulting optimization problem and report the increase in labor costs. Try explaining your result.

Remark: Include your .pdf, .tex, .oplproject, .project, .mod, and .dat files for uploading.

Solution:

(1):

Decision Variables : So, $Staff[S_1...] = timeInterval[X_1...]$ hence.

	X_1	X_2	X_3	X_4	X_5	X_6
Time Period	06-10	10-14	14-18	18-22	22-02	02-06
Staff	700	200	800	300	100	100
	S_1	S_2	S_3	S_4	S_5	S_6

$$X_1 = S_1, X_2 = S_2, X_3 = S_3, X_4 = S_4, X_5 = S_5, X_6 = S_6$$

Objective Function: $\text{MIN } V = X_1 * salary_1 + X_2 * salary_2 + X_3 * salary_3 + X_4 * salary_4 + X_5 * salary_5 + X_6 * salary_6$

Constraints:

$$C_1 = X_1 + X_6 \geq 700$$

$$C_2 = X_1 + X_2 \geq 200$$

$$C_3 = X_2 + X_3 \geq 800$$

$$C_4 = X_3 + X_4 \geq 300$$

$$C_5 = X_4 + X_5 \geq 100$$

$$C_6 = X_5 + X_6 \geq 100$$

Non-negative Constraints

(B):

requirement2 = [700,400,800,300,100,100];

For (2), we will combine that the staff have 8 hour shifts, So in a way that at the minimum corresponding value for staff salary which in our case X_2 will not suffix the amount. Hence keeping the sum of the Minimum cost the same as we got for requirement1 = [700,200,800,300,100,100];

References

https://www.ibm.com/support/knowledgecenter/en/SSSA5P_12.6.0/ilog.odms.ide.help/OPL_Studio/opllang_quickref/topics/tlr_oplf_prevc.html

https://www.math.drexel.edu/~jwd25/CALC1_SPRING_06/lectures/lecture9.html

<https://www.it.uu.se/edu/course/homepage/opt1/old-exams/exam101213.pdf>

<https://www.it.uu.se/edu/course/homepage/opt1/old-exams/exam111216.pdf>

<https://www.it.uu.se/edu/course/homepage/>

Check these websites they have the similar problems and also have provided the solution to some of the problems