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Optimization Methods in Finance

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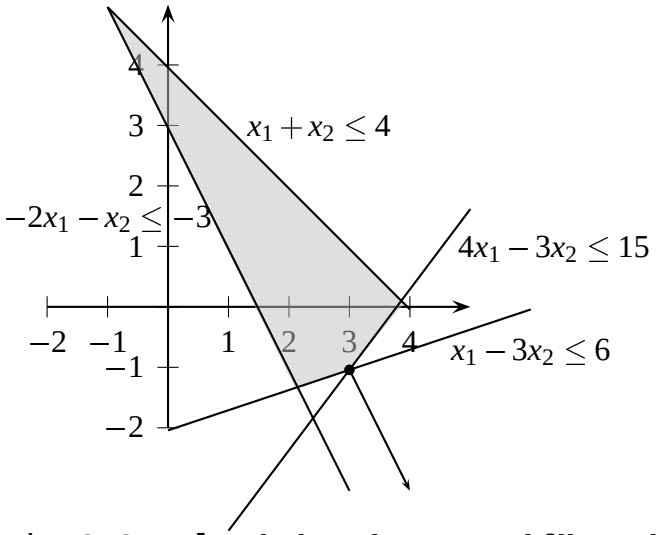
Guide how to use ZIMPL on terminal PCs

1 Intro

For this guide I assume that you use the Linux-PCs in the terminal room. We consider the following example linear program

$$\begin{aligned} \max\ & x_1 - 2x_2 & \\ & x_1 + x_2 &\leq\ 4 \\ & x_1 - 3x_2 &\leq\ 6 \\ & -2x_1 - x_2 &\leq\ -3 \\ & 4x_1 - 3x_2 &\leq\ 15 \end{aligned}$$

The optimum solution is $(x_1, x_2) = (3, -1)$ with an objective function value of 5.

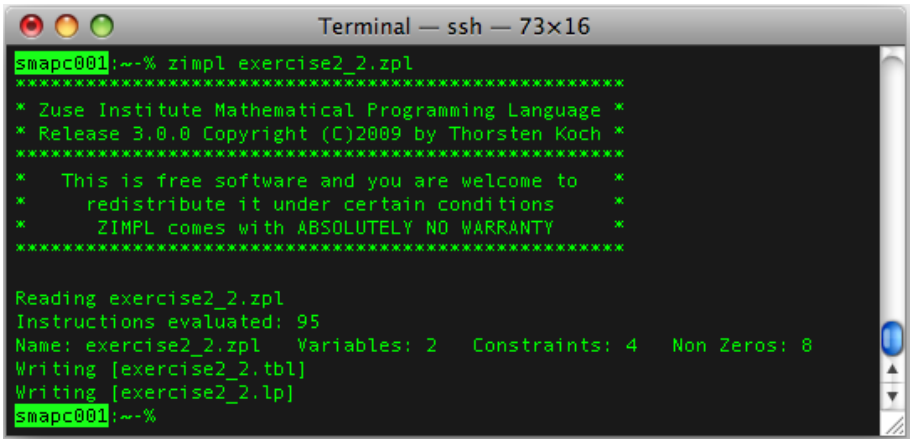


We create a ZIMPL file `exercise2_2.zpl` in the base directory and fill it with

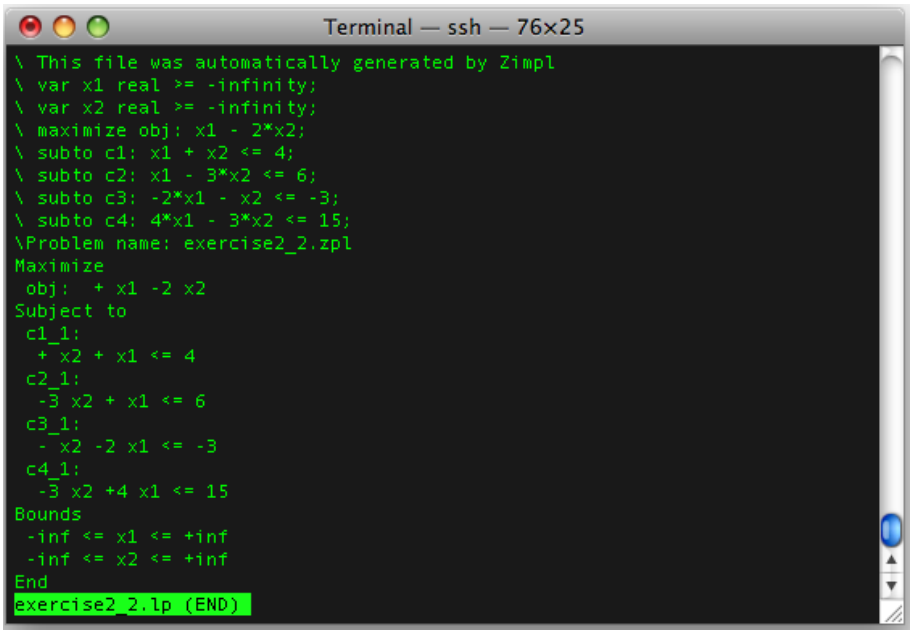
```
# Example from exercise 2.2
# Optimum solution should be x = (3,-1) with value 5

var x1 real >= -infinity;
var x2 real >= -infinity;

maximize obj: x1 - 2*x2;
```

```
subto c1: x1 + x2 <= 4;
subto c2: x1 - 3*x2 <= 6;
subto c3: -2*x1 - x2 <= -3;
subto c4: 4*x1 - 3*x2 <= 15;
```

Then we open a terminal and type `zimpl exercise2_2.zpl` to translate it into a lp file.



The lp file looks as follows

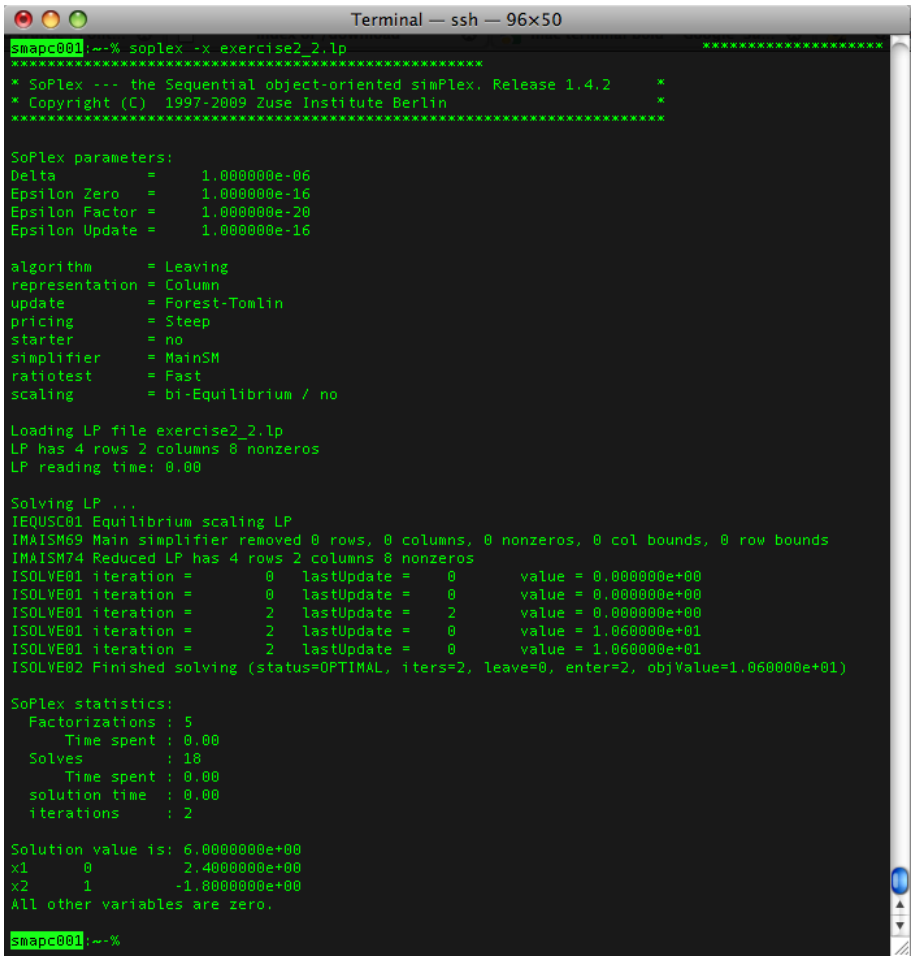


2 Soplex

SOPLEX is a free linear progamming solver that can solve files in the lp format. The command

`soplex -x exercise2_2.lp`

solves the above example. SOPLEX outputs



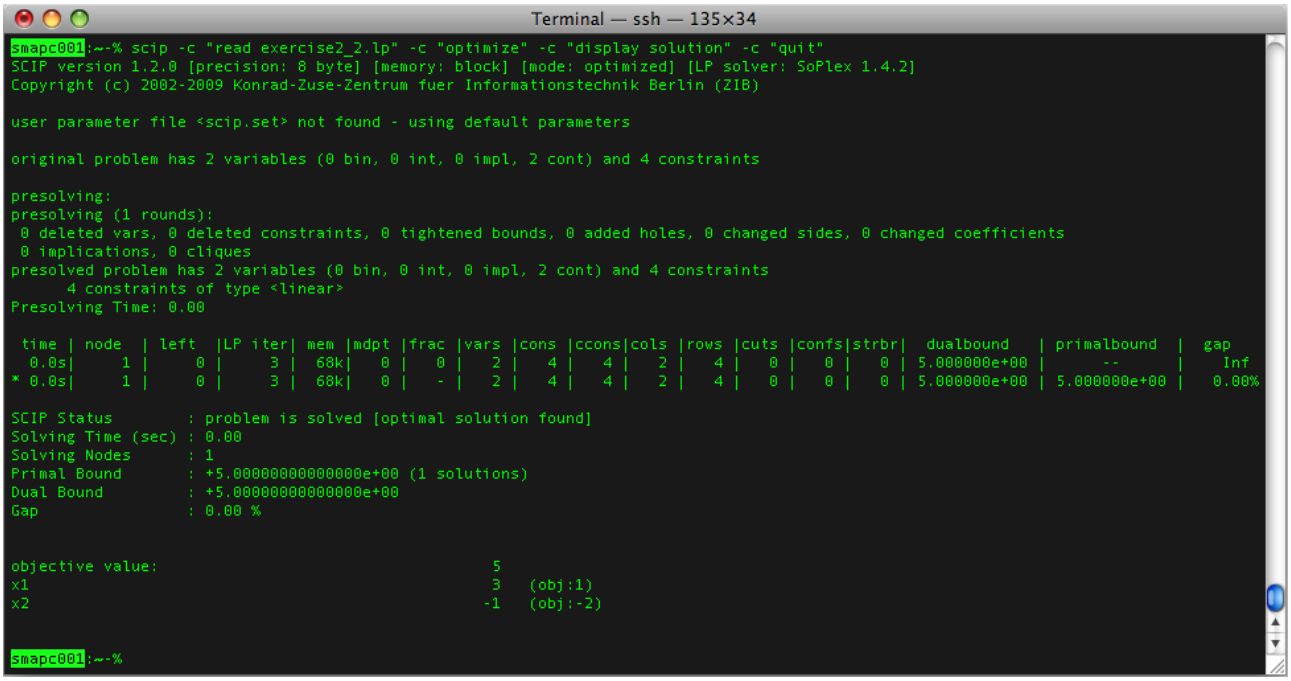
But the returned solution $(x_1, x_2) = (2.4, -1.8)$ is not even feasible[1]. Thus we want to explain in the following, how lp files can be solved with the help of other (seemingly more relyable) tools. We suggest 2 possible options: SCIP and QSOpt.

3 SCIP

SCIP is a free linear *and* integer program solver that can solve programs in the lp format (and in the ZIMPL format). Hence it is a more powerful tool than for example QSOpt. It is already installed on the terminal machines and can be used for example via:

```
scip -c "read exercise2_2.lp" -c "optimize" -c "display solution" -c "quit"
```

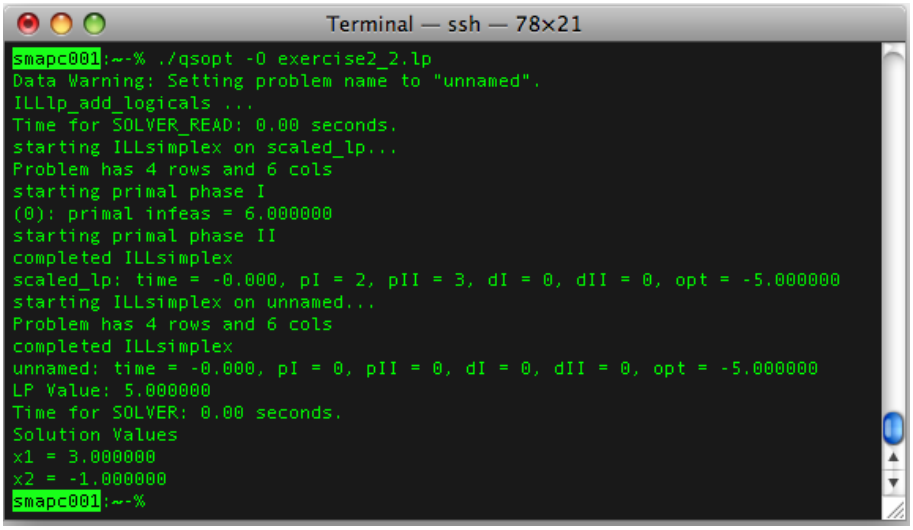
[1] Remark: Also on other examples I did not get any correct answer



4 QSOpt

QSOpt is a free linear program solver that solves files in the lp format. It is not yet installed on the terminal machines, but this can be easily done as follows

1. Download the file http://www2.isye.gatech.edu/~wcook/qsopt/downloads/codes/linux24/qsopt.gz
2. Open a terminal
3. Enter `gunzip qsopt.gz`
4. Enter `chmod 777 qsopt` to make QSOpt executable
5. Enter `./qsopt -O exercise2_2.lp`



5 General remarks

- The command `var x;` in ZIMPL creates a variable with a default lower bound of 0. Better use `var x real >= -infinity;` if you want x to be unbounded, i.e. $x \in \mathbb{R}$.