

Testing Edgecases

Infeasible Start

```
from mip import Model, maximize

m = Model()

x1 = m.add_var(lb = 0) # variables
x2 = m.add_var(lb = 0)

m += x1 + x2 <= 2
m += 2 * x1 + 2 * x2 >= 2 # constraints

m.objective = maximize(x1 - x2)

m.optimize()
```

```
Welcome to the CBC MILP Solver
Version: Trunk
Build Date: Oct 24 2021
```

```
Starting solution of the Linear programming problem using Primal Simplex
```

```
<OptimizationStatus.OPTIMAL: 0>
```

We notice no errors which looks promising.

```
x = [x1.x, x2.x] # get values, not objects
print(f"x: {x}")
```

```
x: [2.0, 0.0]
```

This is a correct solution which brings us to a conclusion that pythonmip correctly handles infeasible start edgecase.

Unboundedness

```
m = Model()

x1 = m.add_var(lb = 0)
x2 = m.add_var(lb = 0)

m += -x1 + x2 <= 1
m += x2 <= 5

m.objective = maximize(2 * x1 + x2)

m.optimize()
```

```
Coin0506I Presolve 0 (-2) rows, 0 (-2) columns and 0 (-4) elements
Clp0000I Optimal - objective value 2
Coin0511I After Postsolve, objective 2, infeasibilities - dual 0 (0), primal 0 (0)
Clp0032I Optimal objective 2 - 0 iterations time 0.002, Presolve 0.00, Idiot 0.00
Starting solution of the Linear programming problem using Primal Simplex
```

```
<OptimizationStatus.UNBOUNDED: 2>
```

Pythonmip correctly finds that a problem is unbounded. Let's see if the variables have been changed.

```
x = [x1.x, x2.x]
print(f"x: {x}")
```

```
x: [None, None]
```

Worth noting: variables get set to None whenever pythonmip identifies an unbounded problem.

Infinite Solutions

```
m = Model()

x1 = m.add_var(lb = 0)
x2 = m.add_var(lb = 0)

m += 5 * x1 + 10 * x2 <= 60
m += 4 * x1 + 4 * x2 <= 40

m.objective = maximize(x1 + x2)
```

We can already see that one of the constraints is a multiple of the objective function, so there's a big chance to have an entire face of solutions. We're interested in seeing which solution the algorithm will give us.

```
m.optimize()

x = [x1.x, x2.x]
print(f"x: {x}")
```

```
Coin0508I Presolve thinks problem is unbounded
Clp3003W Analysis indicates model infeasible or unbounded
Clp1000I sum of infeasibilities 0 - average 0, 0 fixed columns
Coin0508I Presolve thinks problem is unbounded
Clp0029I End of values pass after 1 iterations
Clp0002I Dual infeasible - objective value 13
Clp0002I Dual infeasible - objective value 13
Clp0002I Dual infeasible - objective value 13
Clp0032I DualInfeasible objective 13 - 0 iterations time 0.002, Idiot 0.00
Starting solution of the Linear programming problem using Primal Simplex

x: [10.0, 0.0]
```

So pythonmip just gives us the first seen solution.

The model in matrix standard form

Let's take the previous problem

$$A = \begin{bmatrix} 5 & 10 \\ 4 & 4 \end{bmatrix}, b = \begin{bmatrix} 60 \\ 40 \end{bmatrix}, x = [x[0]]$$