

General structure

- Select mode
- Read data from file
- while not everything feasible
 - Generate year model(year data, feedback)
 - Solve year model
 - Generate month data(year solution)
 - for each month
 - Generate month model(month data)
 - Solve month model
 - If feasible -> next month
 - Generate feedback model(month data)
 - Solve feedback model
- double maxTime

Solving function

```
double Model::solveBasics(int maxTime, bool verbose, clock_t start)
{
    if (!verbose)
        p.setMsgLevel(0);
    string name = p.getName();

    XPRBloadmat(p.getCRef());
    XPRSprob opt_prob = XPRBgetXPRSprob(p.getCRef());
    if (maxTime != 0)
        XPRSsetintcontrol(opt_prob, XPRS_MAXTIME, -maxTime);
    XPRSsetdblcontrol(opt_prob, XPRS_MIPRELSTOP, 0.05);
    //XPRStune(opt_prob, "g");

    p.exportProb(XPRB_LP, ("Output Files/" + name).c_str());
    if (start == 0)
        start = clock();
    p.mipOptimise();
    return ((double)clock() - start) / (double)CLOCKS_PER_SEC;
}
```

Constraint generation

$$s_{v,j} - s_{v,(j-1)} \geq \sum_{i \in I} (a_{v,i,(j-1)} \cdot d_{y,i})$$

$$\forall y \in Y, \forall v \in V_y, \forall j \in J - \{0\}$$

```
void MonthModel::genDurationCon()
{
    for (int y = 0; y < getData()->Y; ++y)
    {
        int VyStart = 0;
        if (y > 0)
            VyStart = getData()->Vy[y-1];

        for (int v = VyStart; v < getData()->Vy[y]; ++v)
            for (int j = 1; j < getData()->J; ++j)
            {
                XPRBrelation ctr = s[v][j] - s[v][j-1] >= a[v][0][j-1] * getData()->d[y][0];

                for (int i = 1; i < getData()->I; ++i)
                    ctr.addTerm(a[v][i][j-1], -1 * getData()->d[y][i]);

                p.newCtr(("Dur_" + to_string(y) + "_" + to_string(v) + "_" + to_string(j)).c_str(), ctr);
            }
    }
}
```

Splitting the problem up

```
MonthModel* monthModel = new MonthModel(&months[m], &mode, "Month", m);  
//monthModel->genProblem();  
monthModel->genPartialProblem(0);  
monthSols[m] = monthModel->solve(maxTime);  
monthModel->genPartialProblem(1);  
monthSols[m] = monthModel->solve(maxTime);
```

```
void MonthModel::genPartialProblem(int it)  
{  
    if (it == 0)  
    {  
        genDecVars();  
        genObj();  
  
        genOrderCon();  
        genLimitCon();  
        genDurationCon();  
        genFixedCons();  
        genFinishCon();  
        genPrecedenceCon();  
        genReleaseCon();  
    }  
    else if (it == 1)  
    {  
        genDeadlineCon();  
        genResourceCon();  
    }  
}
```

Feedback generation

```
void MonthModel::getRequirements(vector<double>* eps, vector<int>* rho, int globalY)
{
    FeedbackModel* model = new FeedbackModel(getData(), mode, id);
    model->genProblem();

    (*eps) = model->getEps(globalY);

    (*rho) = vector<int>(globalY, 0);
    for (int y = 0; y < getData()->Y; ++y)
        for (int i = 0; i < getData()->IMaint; ++i)
            (*rho)[getData()->yTrans[y]] = std::max((*rho)[y], getData()->rho[y][i]);
}
```

```
vector<double> FeedbackModel::getEps(int globalY)
{
    solveBasics(60, false);

    vector<double> res = vector<double>(globalY, 0.0);

    for (int y = 0; y < getData()->Y; ++y)
        res[getData()->yTrans[y]] = max(0.0, this->Ty[y].getSol() - getData()->T);

    return res;
}
```

Problem size

```
Reading Problem Month1
Problem Statistics
  5078 (      0 spare) rows
  2559 (      0 spare) structural columns
 22159 (      0 spare) non-zero elements
Global Statistics
  2457 entities      0 sets      0 set members
FICO Xpress v8.10.0, Hyper, solve started 17:55:25, Mar 9, 2021
Heap usage: 1163KB (peak 1163KB, 15MB system)
Minimizing MILP Month1
Original problem has:
  5078 rows      2559 cols      22159 elements      2457 globals
Presolved problem has:
   0 rows      0 cols      0 elements      0 globals
Presolve finished in 0 seconds
Heap usage: 1379KB (peak 4638KB, 15MB system)
```

```
Reading Problem Month10
Problem Statistics
  23568 (      0 spare) rows
 11699 (      0 spare) structural columns
110026 (      0 spare) non-zero elements
Global Statistics
 11340 entities      0 sets      0 set members
FICO Xpress v8.10.0, Hyper, solve started 18:54:34, Mar 9, 2021
Heap usage: 5203KB (peak 20MB, 114MB system)
Minimizing MILP Month10
Original problem has:
 23568 rows      11699 cols      110026 elements      11340 globals
Presolved problem has:
 18503 rows      8297 cols      75649 elements      7940 globals
LP relaxation tightened
Presolve finished in 0 seconds
Heap usage: 11MB (peak 21MB, 114MB system)
```

- Run program remotely on university PC (potentially faster, and can run in background)
- Experiment more with splitting constraints
- Improve feedback logic