Optimization HW10 Ang Zhou

Question 1

(a)

To formulate the problem into a min-cost network flow problem, I decided to assign costs on each combination of referees and paper. Use 'i' to denote 71 papers, and 'j' to denote 21 papers.
If the referees are assigned to papers that they said "yes, I can definitely review this paper", the costs are 1. If the referees are assigned to papers that they said "I can maybe review this paper", the costs are 10. If the referees are assigned to papers that they said "No, I do not want to review this paper" the costs are 100. If the referees are assigned to papers that they said "I have a conflict of interest with this paper, so it is unethical for me to review this paper" the costs are 10^6, since we definitely do not want a referee to be assigned to a paper if he/she said that.

The cost table would be look like this:

| | Yes | Maybe | No | Definitely Not |
|---|---|---|---|---|
| Costs | 1 | 10 | 100 | 10^6 |

Let Cij denote the cost that assign paper 'i' to referee 'j'.
Let Xij denote the true/false that paper 'i' is assigned to referee 'j', Xij=1 means paper 'i' is assigned to referee 'j'.

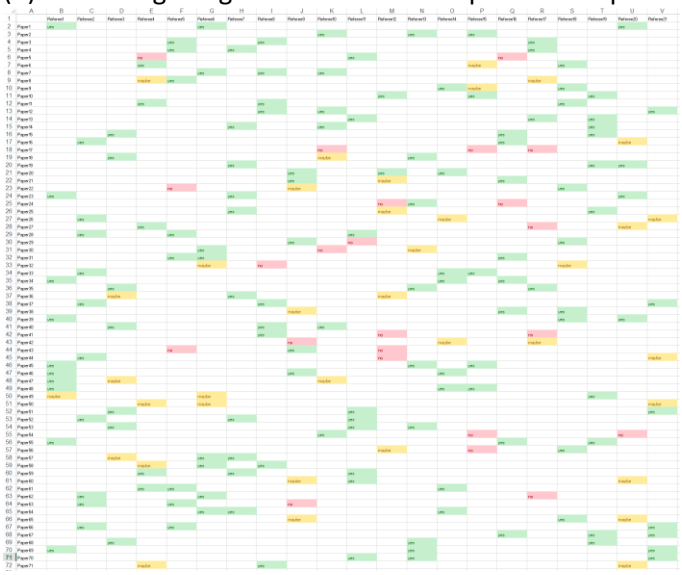
Our objective function would be:

Min $\sum_{i=1}^{71}\sum_{j=1}^{21} Cij * Xij$

Since each paper need to have 3 referees and each referee need to review about 10~11 papers
Our constraints are represented as following:

1) $\sum_{j=1}^{21} Xij = 3$, where i belongs to [1,71]
2) $\sum_{i=1}^{71} Xij \geq 10$, where j belongs to [1,21]
3) $\sum_{i=1}^{71} Xij \leq 11$, where j belongs to [1,21]
4) Xij $\geq 0$
5) Xij $\leq 1$

(b)After using the gurobi to solve this optimization problem, we got the following result:



Code:

```
from gurobipy import *
import xlwt
import xlrd

# loading data
f = xlrd.open_workbook('paper_data.xlsx')
sheet = f.sheet_by_index(0)


# create a new model
myModel = Model("HW10_Q1")

# create decision vats and integrate them into the model
nrows = sheet.nrows-1
ncols = sheet.ncols-1
cost = [[0 for i in range(ncols)] for j in range(nrows)]
myVars = [[0 for i in range(ncols)] for j in range(nrows)]

for i in range(nrows):
   for j in range(ncols):
      curVar = myModel.addVar(vtype=GRB.INTEGER, name='X' + str(i+1) + ',' + str(j+1))
      myVars[i][j] = curVar
      arc = sheet.cell(i+1,j+1).value
      if arc == "yes":
         cost[i][j] = 1
      if arc == "maybe":
         cost[i][j] = 10
      if arc == "no":
         cost[i][j] = 100
      if arc == "conflict":
         cost[i][j] = 1000000
myModel.update()

# create a linear expression for the objective
objExpr = LinExpr()
for i in range(nrows):
   for j in range(ncols):
      curVar = myVars[i][j]
      objExpr += cost[i][j]*curVar
      myModel.setObjective(objExpr, GRB.MINIMIZE)
myModel.update()

# Constraint for each paper having exactly three referees to review
for i in range(nrows):
   constExpr = LinExpr()
   for j in range(ncols):
```

```
        curVar = myVars[i][j]
        constExpr += curVar
    myModel.addConstr(lhs=constExpr, sense=GRB.EQUAL, rhs=3, name="paper" + str(i+1))

# Constraint for each referee having at least 10 paper to review
for j in range(ncols):
    constExpr = LinExpr()
    for i in range(nrows):
        curVar = myVars[i][j]
        constExpr += curVar
    myModel.addConstr(lhs=constExpr, sense=GRB.GREATER_EQUAL, rhs=10,
name="referee_lowerbound" + str(j+1))

# Constraint for each referee having at most 11 paper to review
for j in range(ncols):
    constExpr = LinExpr()
    for i in range(nrows):
        curVar = myVars[i][j]
        constExpr += curVar
    myModel.addConstr(lhs=constExpr, sense=GRB.LESS_EQUAL, rhs=11, name="referee_upperbound" +
str(j+1))

# boundary
for j in range(ncols):
    for i in range(nrows):
        constExpr = LinExpr()
        constExpr = myVars[i][j]
        myModel.addConstr(lhs=constExpr, sense=GRB.LESS_EQUAL, rhs=1, name="boundary" + str(i+1) +
',' + str(j+1))

# integrate objective and constraints into the model
myModel.update()

# write the model in a file to make sure it is constructed correctly
myModel.write(filename="HW10_Q1.lp")

# optimize the model
myModel.optimize()

# save result to xls file
allVars = myModel.getVars()

writebook = xlwt.Workbook()
sheet1 = writebook.add_sheet('test')

for i in range(71):
    for j in range(21):
        if(allVars[21*i+j].x == 1):
```

```
            sheet1.write(i+1,j+1,sheet.cell(i+1,j+1).value)

writebook.save('result.xls')
```