MATH4202/7202 Advanced Topics in Operations Research 2012

Practical Exam

Do not open this exam paper until instructed to do so.

Time allowed: **90** minutes

This exam consists of **2** parts

You may access any online resources, including your notes,
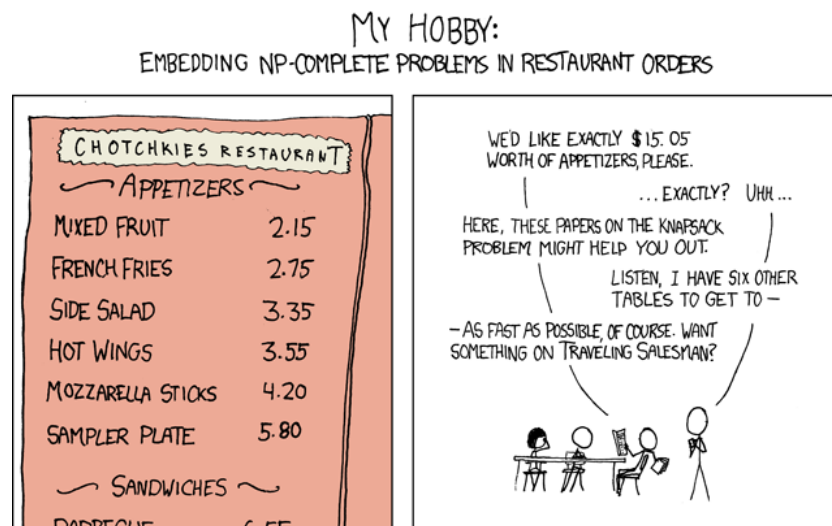but you should not communicate with others during the exam.

Please fill in your details below.

Student number:..

Name:...

Signature:...

Part 1 *(10 marks)*

MY HOBBY:
EMBEDDING NP-COMPLETE PROBLEMS IN RESTAURANT ORDERS

Inspired by this cartoon from *xkcd.com*, a restaurant opens with the aim of attracting Operations Research students and practitioners. They wish to construct a menu with items priced from $1.00 to $2.00, inclusive, in 5 cent increments, so that their mathematician customers can order any exact amount of food between $3.00 and $4.50, inclusive, in 5 cent increments. The menu will contain at most one item at each price and the customers can order at most one of each item.

The restaurant want to know what is the least number of items that can appear on the menu and what are the prices of these items. Model this as an integer programming problem and solve it using Gurobi. You may find the following stub useful:

```
import math
from gurobipy import *


Items = range(100,205,5)
Amounts = range(300,455,5)
nItems = range(len(Items))
nAmounts = range(len(Amounts))
```

Note that the simple solution to this problem will take 5–6 minutes to run.

Part 2 *(10 marks)*

Due to inflation the restaurant changes the range of item prices to be from $2.00 to $3.50 and the range of exact amounts covered to be from $5.00 to $8.00. What is the answer to the menu problem now?

If the method you used in the previous part is no longer working, think about ways to improve it and document and/or implement them. More marks will be given for an implemented solution.