CHRISTMAS BUFFET

Assignment preliminary round
for the 18th Mathematics A-lympiad

November 24, 2006

TEXAS INSTRUMENTS

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Guidelines preliminary assignment Mathematics A-lympiad 2006/2007

This Mathematics A-lympiad assignment consists of two introductory assignments, two follow-up assignments and a final assignment.

General advice for working on the assignment
- First read the full text of the assignment, so that you know what you have to do.
- Keep an eye on the time you are using for the introductory and follow-up assignments; make sure you have enough time left for the final assignment. Divide tasks where possible, and confer when needed.
- If you did divide tasks, discuss the results of the assignments you have done with each other before you start working on the final assignment..
- It is important for the final assignment to give a very clear description of the booking system you have designed.
- The answers for the introductory and follow-up assignments should not be a part of the description of the booking system in the final assignment. Put the results of the introductory and follow-up assignments in an appendix.

Hand in:
- A clear and elaborate description of the booking system.
- In appendices: the results of the introductory and follow-up assignments.

Copies of your work will go to the jury. Please make sure the copies are legible; write in black, only print on A4 paper, preferably do not use a pencil for drawings. Make a copy to check if you are not sure!

Assessment
Among other things, the following points will be taken into account:
- legibility and clarity of the description of the booking system,
- completeness of the work,
- the use of mathematics,
- argumentation used and justification of choices you made (how realistic a proposal is may play a part here),
- the depth of the work,
- style of presentation: including form, legibility, structure, use and function of appendices etc.

Have fun and good luck!

THE CHRISTMAS BUFFET

Introduction

Restaurant Alympia is a Greek restaurant in the centre of a medium-sized town. This year, for the first time, the restaurant's owner, Anastasios Zeus, will organise a Christmas Buffet on Boxing Day. All dishes will be set out on long tables, and guests can fill their plates with no limit. Zeus has put together a drinks arrangement especially for this buffet. Of course, people will have to book in advance for the Christmas Buffet.

Of course Anastasios Zeus wants both a successful Christmas Buffet for his guests and an optimum profit. He needs to take into account several factors, such as: his own expenses (depreciation, purchase and personnel costs), the capacity of the restaurant, guests' wishes etc.

The main problem for Zeus is to get a handle on bookings: he has no idea how many bookings for the Christmas Buffet he will get. Therefore the request to you to set up a good booking system.

That system must result in an *eating roster*, an occupancy plan that satisfies the guests, that keeps the restaurant as full as possible and that optimises the profit for the owner.

In the *introductory and follow-up assignments* you will explore simplified representations of the problem. In the end, in the *final assignment* you will have to make use of all aspects to achieve an optimal booking system for Anastasios Zeus.

Information on the Christmas Buffet

The buffet

Groups can book as a group, in the name of one of the members of the group. There is a choice for how long one wants to eat:: 2 hours, 3 hours or 4 hours. The buffet starts at 17.00 and the restaurant closes at 24.00. People can indicate when they make their booking whether they want to start early (between 17.00 and 20.00) or late (after 20.00). Due to the size of the restaurant and maintaining the Christmas spirit, the groups may not be larger than eight people.
Drinks will be served at the tables by the serving staff; afterwards a pre-defined price per person for the buffet and the drinks arrangement will be paid. Restaurant Alympia has one regular waiter.

The space

The restaurant has room for a maximum of 48 guests at the same time. There are 24 double tables, which the staff can easily move about to create larger tables. There are *never more than two people* at each individual double table. Of course, groups with an odd number of guests and single guests are never placed at a table with other groups. So a group of three would require two double tables!

Prices and expenses

Zeus has prepared the following prices for the Christmas Buffet and the drinks arrangements:

	BUFFET		DRINKS	
	Price buffet	Average cost	Price arrangement	Average cost
2 hr	€ 35	€ 7	€ 15	€ 3
3 hr	€ 45	€ 9	€ 20	€ 4
4 hr	€ 55	€ 11	€ 25	€ 5

All prices are per person.

Fixed expenses for Zeus are € 500,- per night. These include rent, the cook, the regular waiter, his own wages, depreciation on kitchen equipment etc.

The restaurant has a large number of part-time serving staff on call, mostly students from the local hotel school. Mr. Zeus thinks there should be at least one waiter or waitress for every ten guests. On average one waiter or waitress costs (gross) € 15,- an hour. Zeus always arranges in advance how many (consecutive) hours staff will be working.

Introductory assignments

Assignment 1

Assume that Zeus received the following bookings for the Christmas Buffet:

Name	Number of people	Length buffet (in hours)	Start time
1. Marée family	3	4	Early
2. Joris and Gertrude	2	2	Late
3. Van der Gun family	8	4	Late
4. Verbeem family	4	4	Early
5. Marjan and Ruud	2	2	Early
6. Marc and Harriët	4	3	Late
7. Bol family	7	3	Late
8. Kim v. Rijsewijck	5	3	Early
9. Van Woezik family	6	2	Early

Make an eating roster for these guests and calculate the optimum profit for Mr. Zeus for the Christmas Buffet based on these bookings. Show your working method clearly.

Assignment 2

Based on Mr. Zeus' pricing not all groups are as profitable. Give an overview of the factors that determine this; use calculated examples to clarify this. Then calculate the theoretically possible maximum profit for Mr. Zeus on the night of the buffet. Support your calculations and justify your choices!

Follow-up assignments

Anastasios Zeus assumes there will be a rush for the Christmas Buffet. For that reason he has decided to do the bookings on-line. The day after booking has started, he checks his mailbox, which is filled up completely; there are many more bookings than he can ever hope to accommodate in his restaurant. What to do now?

In the appendix you can see the applications that arrived on the first day in chronological order (top to bottom).

Assignment 3

Zeus is overwhelmed by the number of applications. His original intention was to use the principle of 'first come, first served'. Arrange the guests according to this

principle and calculate the resulting profit for Zeus. Represent the full eating roster in an orderly way.

Assignment 4

Work out what the optimal arrangement (the best eating roster) is for Zeus if he were to let go of the principle of 'first come, first served' and arranges the applications according to his own discretion. Clearly indicate your choices and why you make them. Here as well, your work must contain a clear and recognisable representation of the eating roster and all calculations and considerations!

Final assignment

Make use of your findings and experience from the introductory and follow-up assignments!

Zeus is considering organising similar buffets in future, again using internet for bookings (by email).
Set up a system or a number of guidelines to indicate how Zeus should arrange the bookings in that case. The system must contain a ready-made roster (or planning overview), that lets the bookings be arranged practically.
Describe clearly how the system works, so that Zeus and possible new staff can use it easily. Feel free to represent the system as a flow chart or a computer program.

Appendix: reservations after one day

	Name	Number of people	Length buffet (in hours)	Start time
1	Marée family	3	3	Early
2	Joris and Gertrude	2	2	Late
3	Van der Gun family	8	4	Late
4	Verbeem family	4	4	Early
5	Marjan and Ruud	2	2	Early
6	Marc and Harriët	4	3	No preference
7	Bol family	7	3	Late
8	Kim v. Rijsewijck	5	3	Early
9	Van Woezik family	6	2	No preference
10	Kees and Leonie	4	4	Early
11	Fam. Van Iersel	7	3	Late
12	Koen v. Nieuwkerk	3	2	Late
13	Froukje van Eerde	7	2	No preference
14	Bas Schippers	3	3	Early
15	Niels van Iersel	6	4	Early
16	Fam. Joosten	5	2	Late
17	L. van Everdingen	2	3	Early
18	Edward	3	2	Late
19	Van Dijk family	2	2	Early
20	R.M.L. Luyendijk	4	3	No preference
21	Paul Thiel	5	4	Early
22	Iris and Corné	5	2	Early
23	Wil and Adrie	2	3	Late
24	Van der Wurf family	8	4	Early
25	Tea Sprong	6	3	No preference
26	Sandra and Alex	2	4	No preference
27	Fam Dijkgraaf	6	2	Late
28	Werner v. d. Put	2	3	Early
29	Versteegh family	7	3	Late
30	H. Benders	8	2	Early
31	Harrie Spek	2	3	Early
32	Kerkstra family	3	2	Late
33	Bettine van Hunnik	2	2	Late
34	Marco and Rinie	2	3	No preference
35	Ben and Thea	2	3	Late
36	Lars and Tom	4	2	Early
37	Sanne Postema	3	3	No preference
38	Esmée and Marit	2	2	Late
39	Marjolein and Marc	2	4	Early
40	Mark and Gea	4	2	Late
41	Wiggerman family	5	4	Early
42	Mevr. De Haan	4	2	No preference
43	Wijers family	5	3	Late
44	J. de Lange	4	2	Early