UTILISATION OF ELECTRONIC FARE COLLECTION DATA OF URBAN BUS OPERATORS WITH REGARD TO TRANSFER JOURNEYS AND ORIGIN/DESTINATION ESTIMATION

By

Markus Hofmann

Supervisor(s): Dr. Simon Wilson, Prof. Peter White

Declaration

I herby certify that this material, which I now submit for assessment on the programme of study leading to the award of **M.Sc. in Computing** in the Institute of Technology Blanchardstown, is entirely my own work except where otherwise stated, and has not been submitted for assessment for an academic purpose at this or any other academic institution other than in partial fulfillment of the requirements of that stated above.

Dated: 10 October 2005

Author:

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Markus Hofmann

Abstract

Despite the fact that an abstract is quite brief, it must do almost as much work as the multi-page paper that follows it. In a computer science paper, this means that it should in most cases include the following sections. Each section is typically a single sentence, although there is room for creativity. In particular, the parts may be merged or spread among a set of sentences. Use the following as a checklist for your next abstract (URL: http://www.ece.cmu.edu/ koopman/essays/abstract.html):

Motivation: Why do we care about the problem and the results? If the problem isn't obviously "interesting" it might be better to put motivation first; but if your work is incremental progress on a problem that is widely recognized as important, then it is probably better to put the problem statement first to indicate which piece of the larger problem you are breaking off to work on. This section should include the importance of your work, the difficulty of the area, and the impact it might have if successful.

Problem statement: What problem are you trying to solve? What is the scope of your work (a generalized approach, or for a specific situation)? Be careful not to use too much jargon. In some cases it is appropriate to put the problem statement before the motivation, but usually this only works if most readers already understand why the problem is important.

Approach: How did you go about solving or making progress on the problem? Did you use simulation, analytic models, prototype construction, or analysis of field data for an actual product? What was the extent of your work (did you look at one application program or a hundred programs in twenty different programming languages?) What important variables did you control, ignore, or measure?

Results: What's the answer? Specifically, most good computer architecture papers conclude that something is so many percent faster, cheaper, smaller, or otherwise better than something else. Put the result there, in numbers. Avoid vague, hand-waving results such as "very", "small", or "significant." If you must be vague, you are only given license to do so when you can talk about orders-of-magnitude improvement. There is a tension here in that you should not provide numbers that can be easily misinterpreted, but on the other hand you don't have room for all the caveats.

Conclusions: What are the implications of your answer? Is it going to change the world (unlikely), be a significant "win", be a nice hack, or simply serve as a road sign indicating that this path is a waste of time (all of the previous results are useful). Are your results general, potentially generalizable, or specific to a particular case?

Acknowledgements

I would like to thank Dr. Simon Wilson...

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Abbreviations

ADA	Americans Disability Act
AVAS	Automated Voice Annunciation System
AVL	Automatic Vehicle Location
CBD	Central Business District
CBR	Case-Based Reasoning
CIE	Córas Iompair Éireann
CTA	Chicago Transport Authority
DD	Double Decks

Chapter 1

Introduction and Background

1.1 section header 1

1.1.1 Subsection header 1

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1.1.2 Subsection header 2

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1.1.3 Subsection header 3

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1.2 section header 2

1.2.1 Subsection header 1

Figure 1.1 shows a spatial map of the GDA.
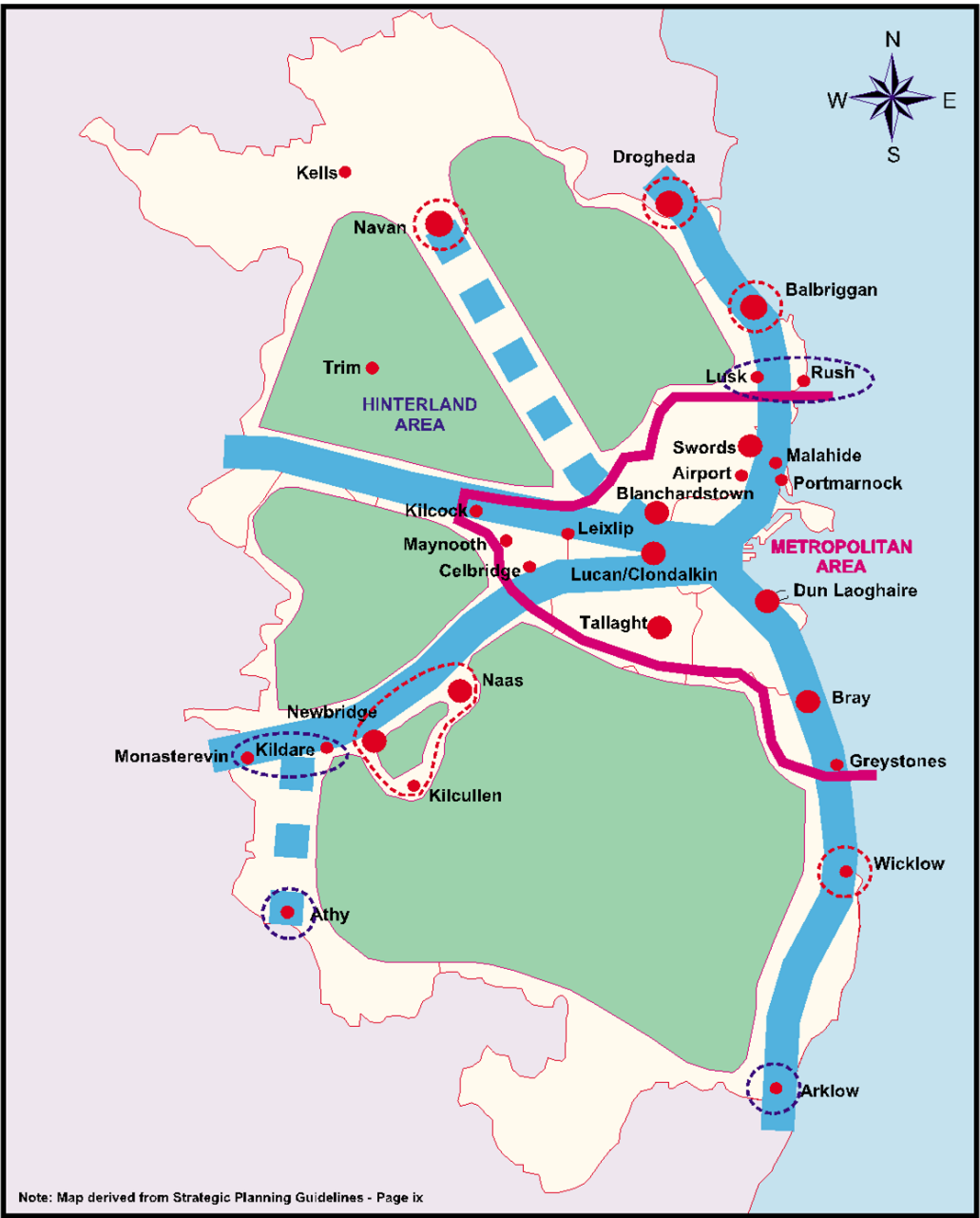
Figure 1.1: Map of the Greater Dublin Area (**?**)

Table 1.1: Demographic Projections of the GDA

Greater Dublin Area	1991	1996	1999	2016
Population (million)	1.35	1.41	1.46	1.75
Households ('000)	402	446	521	675
Employment ('000)	452	549	681	878
Unemployment rate	16%	12%	6%	5%
Car Ownership (per 1000 population)	247	292	342	480
% Growth in GDP since 1991	-	42%	79%	260%

Figure 1.2: Map of Bus Routes of Dublin Bus

The figures shown in Table 1.1 are taken from the website of Dublin Bus (DB, 2005). The bus fleet is broken down into depot location and bus category.

1.2.2 Subsection header 2

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1.2.3 Subsection header 3

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1.3   section header 3

1.3.1   Subsection header 1

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1.3.2   Subsection header 2

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1.3.3   Subsection header 3

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1.4   section header 4

1.4.1   Subsection header 1

Latex is very good when mathematical formulas need to be displayed:

$$S_{ij} = 1 - \frac{|(F_{ij} - F_{ij}^T)|}{(F_{ij} + F_{ij}^T)} \tag{1.4.1}$$

1.4.2   Subsection header 2

1.4.3   Subsection header 3

Chapter 2

Literature Review

2.1   section header 1

2.1.1   Subsection header 1

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2.3 section header 3

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2.4.1 Subsection header 1

2.4.2 Subsection header 2

2.4.3 Subsection header 3

Chapter 3

Methodology Chapter

3.1 section header 1

3.1.1 Subsection header 1

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3.1.2 Subsection header 2

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3.4.2   Subsection header 2

3.4.3   Subsection header 3

Bibliography

DB. Dublin Bus - Mission Statement. online, http://www.dublinbus.ie, (last accessed: October 2005), 2005.

Appendices

Appendix A

Structure of Dublin Bus Wayfarer Data

Introduction

Dublin Bus uses electronic fareboxes

Appendix B

Coarse Zone Description

Coarse Zone	Coarse Zone Description
1	City Centre (within Canal Ring)
2	Dublin Port Area
3	North East City (Clontarf, Raheny, Ayrfield)
4	North West City (Cabra, Finglas, Ballymun)
5	South East City (Rathmines)
6	South West City (Kilmainham, Walkingstown, Kimmage)
7	Fingal West (Blanchardstown / Castleknock)
8	Fingal East (Portmarnock, Malahide, Donabate, Swords, Airport)
9	Fingal North West (Naul, Ballyboghill, Oldtown)
10	Fingal North East (Rush, Lusk, Skerries, Balbriggan)
11	South Dublin - Lucan, Clondalkin
12	South Dublin - Tallaght
13	South Dublin - Saggart, Rathcoole, Bohernabrena
14	Dun Laogharie / Rathdown - North
15	Dun Laoghaire / Rathdown - South
16	Meath
17	Kildare
18	West Wicklow
19	East Wicklow
20	Louth
21	Externals

Appendix C

Coarse Zone Map

Appendix D

Ticket Types

Ticket Type ID	Description
300	Feeder Ticket - Child
301	Feeder Ticket - Adult
310	10-Journey Feeder - Adult
317	Airlink Adult Airport-Busarus
318	Airlink Child Airport-Busarus
319	Airlink Child Airport-Heuston
320	Airlink Adult Airport-Heuston
333	Adult Single Feeder
365	Child Bus/Rail Short Hop - Day
366	Adult Bus/Rail Short Hop - Day
367	Family Bus/Rail Short Hop - Day
369	4 Day Explorer
410	Weekly Adult Short Hop Bus/Rail
430	Weekly Adult Medium Hop Bus/Rail
431	Weekly Adult Long Hop Bus/Rail
432	Weekly Adult Giant Hop Bus/Rail
433	Monthly Adult Short Hop Bus/Rail
455	Monthly Adult Long Hop Bus/Rail
456	Monthly Adult Giant Hop Bus/Rail
457	Monthly Student Short Hop Bus/Rail
458	Annual Bus/Rail
478	Annual All CIE Services
479	Annual CIE Pensioner Bus/Rail
480	Monthly CIE Pensioner Bus/Rail
493	Foreign Student - 1 Week
494	Foreign Student - 2 Week
495	Foreign Student - 3 Week
496	Foreign Student - 4 Week
497	CYC Group
600	Adult Cash Fare
608	Nitelink (Maynouth/Celbridge)
609	Nitelink (Maynouth/Celbridge)
610	Child Cash Fare
620	Schoolchild Cash Fare
625	Adult (formerly Shopper)
630	Adult 10-Journey (3 Stages)
631	Adult 10-Journey (7 Stages)
632	Adult 10-Journey (12 Stages)
633	Adult 10-Journey (23 Stages)
634	Adult 10-Journey (23+ Stages)
640	Adult 2-Journey (3 Stages)
641	Adult 2-Journey (7 Stages)
642	Adult 2-Journey (12 Stages)

Ticket Type ID	Description
643	Adult 2-Journey (23 Stages)
644	Adult 2-Journey (23+ Stages)
650	Schoolchild 10-Journey
651	Scholar 10-Journey
652	Schoolchild 2-Journey
653	Scholar 2-Journey
657	Transfer 90 (or Passenger Change)
658	Adult Single Heuston-CC
660	Adult One Day Travelwide
661	Child One Day Travelwide
662	Family One Day Travelwide
665	Rambler (3 Day Bus only)
670	Weekly Adult Bus
671	Weekly Adult Cityzone
690	Weekly Student Travelwide
691	Weekly Student Cityzone
705	Monthly Adult Citizone (AerLingus.)
710	Monthly Adult Travelwide
730	Annual Adult Travelwide
760	Annual Staff Bus
790	School Pass
791	OAP Pass
800	City Tour - Adult
801	City Tour - Family
802	City Tour - Child
898	10 - Journey Test Ticket

Appendix E
Ticket 1 – 730-243

Date	Stage	Boarding Time	Route	Direction	Zone	Area
01/10/1999	62	08:03	150	1	12	Templeogue
01/10/1999	25	18:26	150	0	1	City Centre South
02/10/1999	70	10:03	16	1	6	Harolds Cross
02/10/1999	25	14:38	16	0	1	City Centre North
04/10/1999	62	08:29	150	1	12	Templeogue
04/10/1999	25	18:37	150	0	1	City Centre South
05/10/1999	62	08:07	150	1	12	Templeogue
05/10/1999	25	17:21	150	0	1	City Centre South
06/10/1999	62	07:49	150	1	12	Templeogue
06/10/1999	25	17:25	150	0	1	City Centre South
08/10/1999	62	08:12	150	1	12	Templeogue
08/10/1999	25	18:13	150	0	1	City Centre South
11/10/1999	62	08:37	150	1	12	Templeogue
11/10/1999	25	18:12	150	0	1	City Centre South
12/10/1999	62	07:27	150	1	12	Templeogue
12/10/1999	25	14:47	150	0	1	City Centre South
13/10/1999	62	08:17	150	1	12	Templeogue
13/10/1999	25	13:34	150	0	1	City Centre South
16/10/1999	70	08:07	65B	1	5	Rathmines
16/10/1999	25	12:47	16	0	1	City Centre North
19/10/1999	62	08:10	150	1	12	Templeogue
19/10/1999	25	16:28	150	0	1	City Centre South
20/10/1999	62	08:13	150	1	12	Templeogue
20/10/1999	25	18:22	150	0	1	City Centre South
21/10/1999	62	08:09	150	1	12	Templeogue
21/10/1999	25	16:17	150	0	1	City Centre South
22/10/1999	62	08:14	150	1	12	Templeogue
22/10/1999	25	17:45	150	0	1	City Centre South
27/10/1999	62	08:11	150	1	12	Templeogue
27/10/1999	25	17:36	150	0	1	City Centre South
28/10/1999	62	08:18	150	1	12	Templeogue
28/10/1999	25	17:47	150	0	1	City Centre South
29/10/1999	62	08:00	150	1	12	Templeogue
29/10/1999	25	18:07	150	0	1	City Centre South
30/10/1999	70	09:15	16A	1	6	Harolds Cross
30/10/1999	25	14:53	155	0	0	City Centre South

Appendix F

Ticket 3 – 730-73

Date	Stage	Boarding Time	Route	Direction	Zone	Area
01/10/1999	15	07:45	130	1	3	Clontarf
01/10/1999	75	17:17	130	0	1	City Centre North
04/10/1999	14	07:49	130	1	3	Clontarf
04/10/1999	75	17:36	130	0	1	City Centre North
05/10/1999	14	07:55	130	1	3	Clontarf
05/10/1999	75	17:22	130	0	1	City Centre North
06/10/1999	13	07:42	130	1	3	Clontarf
06/10/1999	75	17:28	130	0	1	City Centre North
08/10/1999	14	07:56	130	1	3	Clontarf
08/10/1999	75	17:32	130	0	1	City Centre North
11/10/1999	15	07:43	130	1	3	Clontarf
11/10/1999	75	17:24	130	0	1	City Centre North
12/10/1999	15	07:53	130	1	3	Clontarf
12/10/1999	75	17:26	130	0	1	City Centre North
13/10/1999	15	07:53	130	1	3	Clontarf
13/10/1999	75	17:28	130	0	1	City Centre North
14/10/1999	15	07:58	130	1	3	Clontarf
14/10/1999	75	18:51	130	0	1	City Centre North
15/10/1999	15	07:53	130	1	3	Clontarf
15/10/1999	75	17:10	130	0	1	City Centre North
20/10/1999	14	07:46	130	1	3	Clontarf
20/10/1999	75	17:29	130	0	1	City Centre North
21/10/1999	15	08:07	130	1	3	Clontarf
21/10/1999	75	18:39	130	0	1	City Centre North
22/10/1999	16	08:07	130	1	3	Clontarf
22/10/1999	75	17:01	130	0	1	City Centre North
26/10/1999	15	07:51	130	1	3	Clontarf
26/10/1999	75	17:36	130	0	1	City Centre North
27/10/1999	15	07:52	130	1	3	Clontarf
27/10/1999	75	17:34	130	0	1	City Centre North
28/10/1999	15	08:09	130	1	3	Clontarf
28/10/1999	75	18:34	130	0	1	City Centre North
29/10/1999	14	07:59	130	1	3	Clontarf
29/10/1999	75	17:21	130	0	1	City Centre North