

Introduction to Databases

Call Center of a Small Israeli Bank

Extensively used in Homeworks.

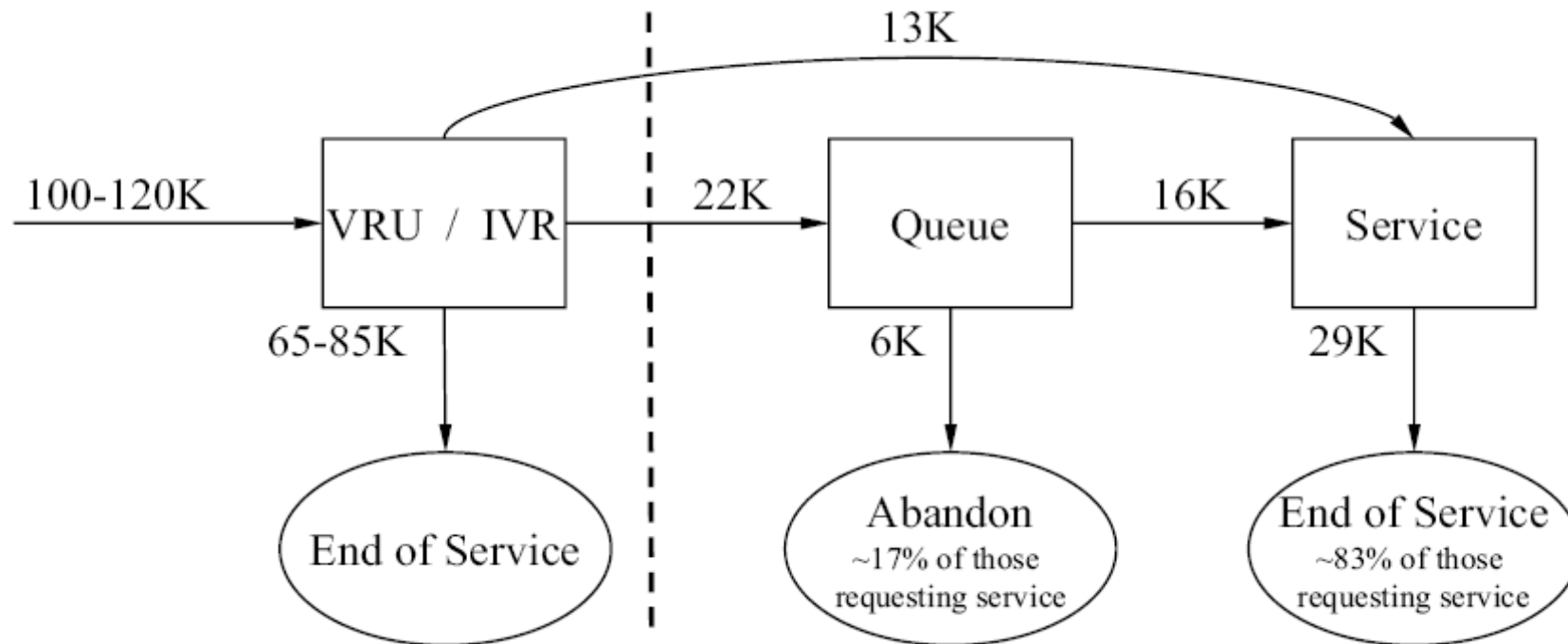
General Data

- The data represents 12 months during 1999.
- Customers that dial “agent-service” phone are registered in the database. Approximately 440000 calls per year.
 - Working hours: weekdays, 7am-12pm; Friday, 7am-2pm, Saturday 8pm-12pm.
 - 8 Agent positions, 1 shift-supervisor, 5 Internet positions.

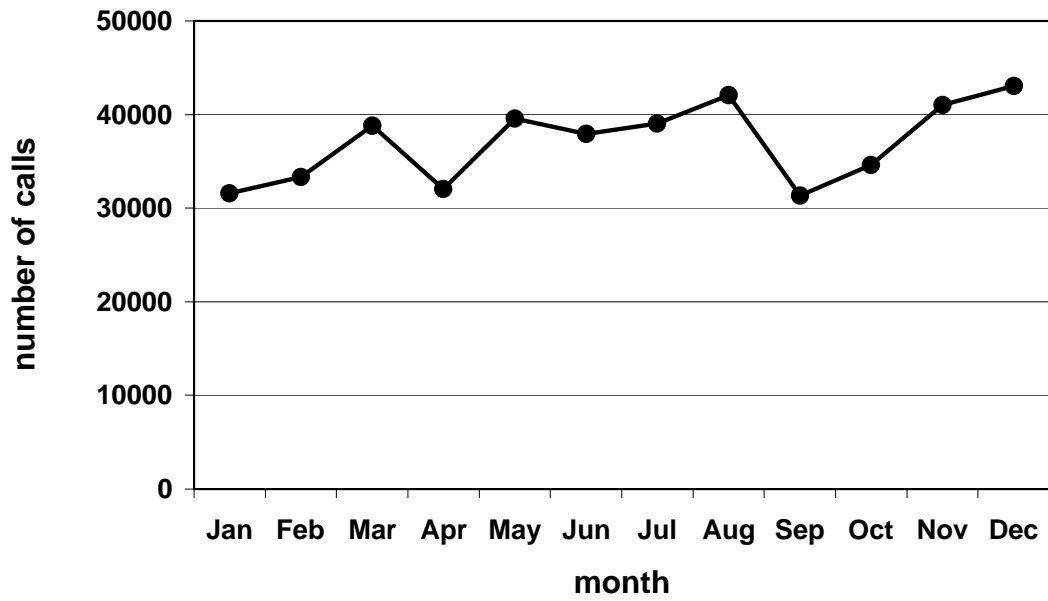
Service Types

- PS – (68%) פעילות שוטפת
- NE – (9%) ניירות ערך
- NW – (15%) חדשים
- IN – (5%) אינטרנט
- TT – outbound (3%)
- PE – (0.5%) אנגלית

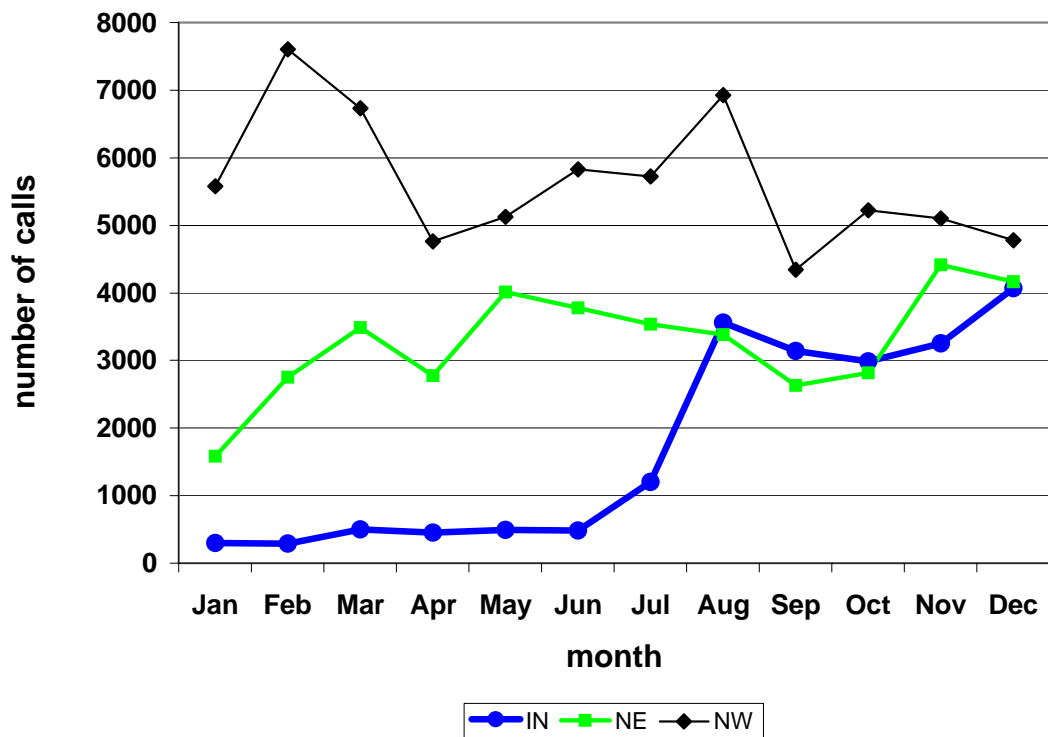
Event History of an Incoming Call (units of rates are calls per month)



Number of calls per month.



Number of calls per type



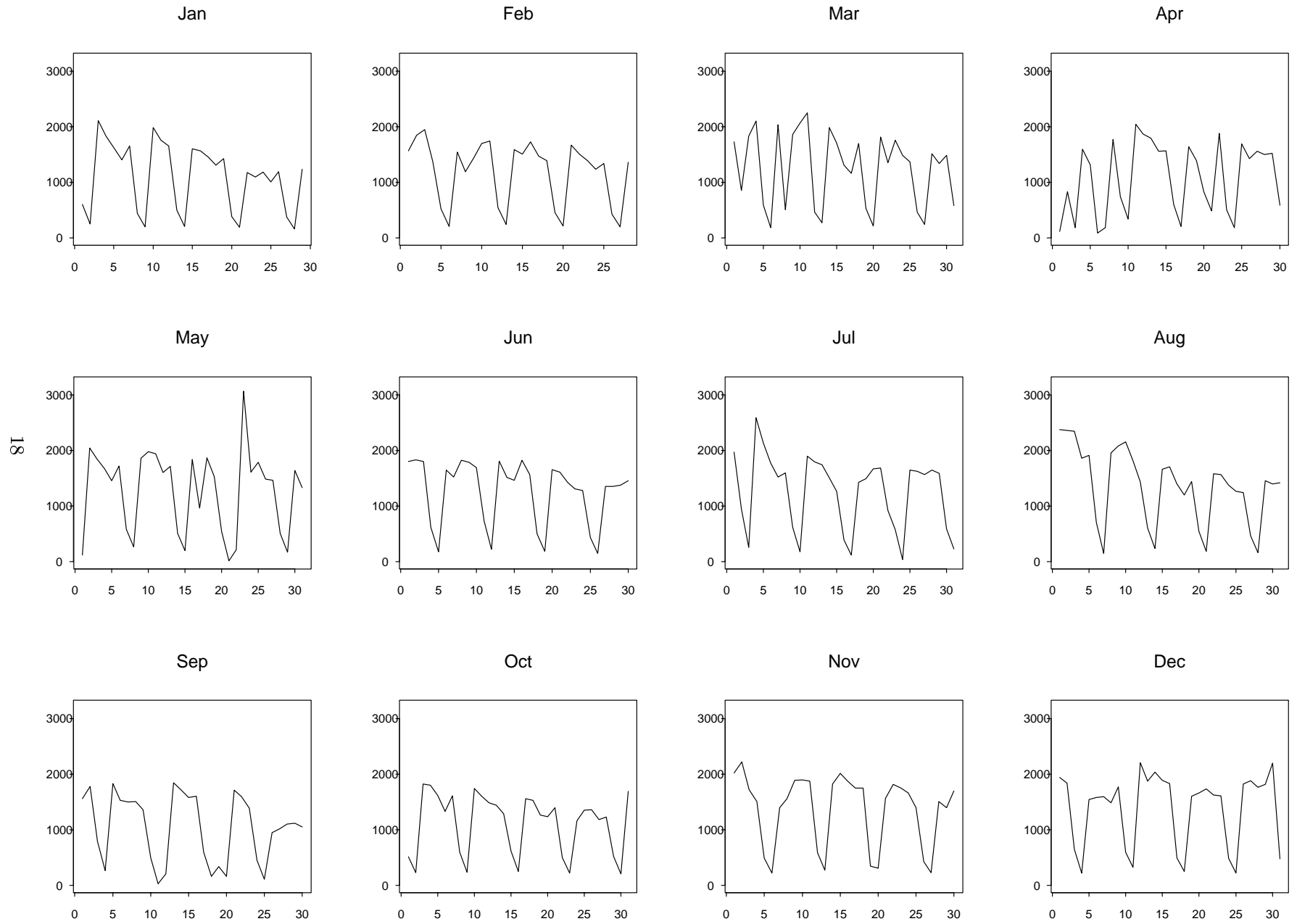


Figure 6: Number of calls per day

Call by Call Data

A Data Sample (Excel worksheet)

vru+line	call_id	customer_id	priority	type	date	vru_entry	vru_exit	vru_time	q_start	q_exit	q_time	outcome	ser_start	ser_exit	ser_time	server
AA0101	44749	27644400	2	PS	990901	11:45:33	11:45:39	6	11:45:39	11:46:58	79	AGENT	11:46:57	11:51:00	243	DORIT
AA0101	44750	12887816	1	PS	990905	14:49:00	14:49:06	6	14:49:06	14:53:00	234	AGENT	14:52:59	14:54:29	90	ROTH
AA0101	44967	58660291	2	PS	990905	14:58:42	14:58:48	6	14:58:48	15:02:31	223	AGENT	15:02:31	15:04:10	99	ROTH
AA0101	44968	0	0	NW	990905	15:10:17	15:10:26	9	15:10:26	15:13:19	173	HANG	00:00:00	00:00:00	0	NO_SERVER
AA0101	44969	63193346	2	PS	990905	15:22:07	15:22:13	6	15:22:13	15:23:21	68	AGENT	15:23:20	15:25:25	125	STEREN
AA0101	44970	0	0	NW	990905	15:31:33	15:31:47	14	00:00:00	00:00:00	0	AGENT	15:31:45	15:34:16	151	STEREN
AA0101	44971	41630443	2	PS	990905	15:37:29	15:37:34	5	15:37:34	15:38:20	46	AGENT	15:38:18	15:40:56	158	TOVA
AA0101	44972	64185333	2	PS	990905	15:44:32	15:44:37	5	15:44:37	15:47:57	200	AGENT	15:47:56	15:49:02	66	TOVA
AA0101	44973	3.06E+08	1	PS	990905	15:53:05	15:53:11	6	15:53:11	15:56:39	208	AGENT	15:56:38	15:56:47	9	MORIAH
AA0101	44974	74780917	2	NE	990905	15:59:34	15:59:40	6	15:59:40	16:02:33	173	AGENT	16:02:33	16:26:04	1411	ELI
AA0101	44975	55920755	2	PS	990905	16:07:46	16:07:51	5	16:07:51	16:08:01	10	HANG	00:00:00	00:00:00	0	NO_SERVER
AA0101	44976	0	0	NW	990905	16:11:38	16:11:48	10	16:11:48	16:11:50	2	HANG	00:00:00	00:00:00	0	NO_SERVER
AA0101	44977	33689787	2	PS	990905	16:14:27	16:14:33	6	16:14:33	16:14:54	21	HANG	00:00:00	00:00:00	0	NO_SERVER
AA0101	44978	23817067	2	PS	990905	16:19:11	16:19:17	6	16:19:17	16:19:39	22	AGENT	16:19:38	16:21:57	139	TOVA
AA0101	44764	0	0	PS	990901	15:03:26	15:03:36	10	00:00:00	00:00:00	0	AGENT	15:03:35	15:06:36	181	ZOHARI
AA0101	44765	25219700	2	PS	990901	15:14:46	15:14:51	5	15:14:51	15:15:10	19	AGENT	15:15:09	15:17:00	111	SHARON
AA0101	44766	0	0	PS	990901	15:25:48	15:26:00	12	00:00:00	00:00:00	0	AGENT	15:25:59	15:28:15	136	ANAT
AA0101	44767	58859752	2	PS	990901	15:34:57	15:35:03	6	15:35:03	15:35:14	11	AGENT	15:35:13	15:35:15	2	MORIAH
AA0101	44768	0	0	PS	990901	15:46:30	15:46:39	9	00:00:00	00:00:00	0	AGENT	15:46:38	15:51:51	313	ANAT
AA0101	44769	78191137	2	PS	990901	15:56:03	15:56:09	6	15:56:09	15:56:28	19	AGENT	15:56:28	15:59:02	154	MORIAH
AA0101	44770	0	0	PS	990901	16:14:31	16:14:46	15	00:00:00	00:00:00	0	AGENT	16:14:44	16:16:02	78	BENSION
AA0101	44771	0	0	PS	990901	16:38:59	16:39:12	13	00:00:00	00:00:00	0	AGENT	16:39:11	16:43:35	264	VICKY
AA0101	44772	0	0	PS	990901	16:51:40	16:51:50	10	00:00:00	00:00:00	0	AGENT	16:51:49	16:53:52	123	ANAT
AA0101	44773	0	0	PS	990901	17:02:19	17:02:28	9	00:00:00	00:00:00	0	AGENT	17:02:28	17:07:42	314	VICKY
AA0101	44774	32387482	1	PS	990901	17:18:18	17:18:24	6	17:18:24	17:19:01	37	AGENT	17:19:00	17:19:35	35	VICKY
AA0101	44775	0	0	PS	990901	17:38:53	17:39:05	12	00:00:00	00:00:00	0	AGENT	17:39:04	17:40:43	99	TOVA
AA0101	44776	0	0	PS	990901	17:52:59	17:53:09	10	00:00:00	00:00:00	0	AGENT	17:53:08	17:53:09	1	NO_SERVER
AA0101	44777	37635950	2	PS	990901	18:15:47	18:15:52	5	18:15:52	18:16:57	65	AGENT	18:16:56	18:18:48	112	ANAT
AA0101	44778	0	0	NE	990901	18:30:43	18:30:52	9	00:00:00	00:00:00	0	AGENT	18:30:51	18:30:54	3	MORIAH
AA0101	44779	0	0	PS	990901	18:51:47	18:52:02	15	00:00:00	00:00:00	0	AGENT	18:52:02	18:55:30	208	TOVA
AA0101	44780	0	0	PS	990901	19:19:04	19:19:17	13	00:00:00	00:00:00	0	AGENT	19:19:15	19:20:20	65	MEIR
AA0101	44781	0	0	PS	990901	19:39:19	19:39:30	11	00:00:00	00:00:00	0	AGENT	19:39:29	19:41:42	133	BENSION
AA0101	44782	0	0	NW	990901	20:08:13	20:08:25	12	00:00:00	00:00:00	0	AGENT	20:08:28	20:08:41	13	NO_SERVER
AA0101	44783	0	0	PS	990901	20:23:51	20:24:05	14	00:00:00	00:00:00	0	AGENT	20:24:04	20:24:33	29	BENSION
AA0101	44784	0	0	NW	990901	20:36:54	20:37:14	20	00:00:00	00:00:00	0	AGENT	20:37:13	20:38:07	54	BENSION
AA0101	44785	0	0	PS	990901	20:50:07	20:50:16	9	00:00:00	00:00:00	0	AGENT	20:50:15	20:51:32	77	BENSION
AA0101	44786	0	0	PS	990901	21:04:41	21:04:51	10	00:00:00	00:00:00	0	AGENT	21:04:50	21:05:59	69	TOVA
AA0101	44787	0	0	PS	990901	21:25:00	21:25:13	13	00:00:00	00:00:00	0	AGENT	21:25:13	21:28:03	170	AVI
AA0101	44788	0	0	PS	990901	21:50:40	21:50:54	14	00:00:00	00:00:00	0	AGENT	21:50:54	21:51:55	61	AVI
AA0101	44789	9103060	2	NE	990901	22:05:40	22:05:46	6	22:05:46	22:09:52	246	AGENT	22:09:51	22:13:41	230	AVI
AA0101	44790	14558621	2	PS	990901	22:24:11	22:24:17	6	22:24:17	22:26:16	119	AGENT	22:26:15	22:27:28	73	VICKY
AA0101	44791	0	0	PS	990901	22:46:27	22:46:37	10	00:00:00	00:00:00	0	AGENT	22:46:36	22:47:03	27	AVI
AA0101	44792	67158097	2	PS	990901	23:05:07	23:05:13	6	23:05:13	23:05:30	17	AGENT	23:05:29	23:06:49	80	VICKY
AA0101	44793	15317126	2	PS	990901	23:28:52	23:28:58	6	23:28:58	23:30:08	70	AGENT	23:30:07	23:35:03	296	DARMON
AA0101	44794	0	0	PS	990902	00:10:47	00:12:05	78	00:00:00	00:00:00	0	HANG	00:00:00	00:00:00	0	NO_SERVER
AA0101	44795	0	0	PS	990902	07:16:52	07:17:01	9	00:00:00	00:00:00	0	AGENT	07:17:01	07:17:44	43	ANAT
AA0101	44796	0	0	PS	990902	07:50:05	07:50:16	11	00:00:00	00:00:00	0	AGENT	07:50:16	07:53:03	167	STEREN

Skip

Debugging database

Combinations of VRU, queue and service times.

VRU	<0		0				>0				Total
	>0		0		>0		0		>0		
	0	>0	0	>0	0	>0	0	>0	0	>0	
Jan	11	22	328	2	127	189	1064	13300	2978	13578	31599
Feb	2	23	355	2	55	255	1653	13028	3828	14143	33344
Mar	8	19	608	0	107	419	1380	8647	8420	19193	38801
Apr	6	31	600	2	44	224	1902	8187	5561	15479	32036
May	30	48	558	2	48	268	1601	10870	6913	19215	39553
Jun	4	23	433	1	47	264	1396	14112	4563	17092	37935
Jul	12	34	598	2	55	264	1692	9683	6738	19944	39022
Aug	4	15	547	1	61	124	2602	12966	7151	18607	42078
Sep	4	10	279	0	29	81	1370	16055	2529	11014	31371
Oct	2	2	186	2	19	63	1370	21020	2039	9922	34625
Nov	2	18	408	1	100	174	1463	14771	5338	18744	41019
Dec	3	17	490	0	93	181	1708	13978	6338	20257	43065
Total	88	262	5390	15	785	2506	19201	156617	62396	197188	444448
%	-	0.1	1.2	-	0.2	0.6	4.3	35.2	14	44.4	100

Bank data

Date	Cust ID	Stat ID	Server ID	Arrival	Service start	Service end	Waiting time	Service time
300594	3003	5	14	8:26:17	8:29:49	8:33:47	3.533	3.967
300594	3005	5	12	8:26:55	8:34:15	8:37:31	7.333	3.267
300594	3006	5	14	8:26:58	8:33:47	8:39:06	6.817	5.317
300594	3006	3	10	8:39:06	8:39:06	8:43:49	0	4.717
300594	3007	5	16	8:27:01	8:29:10	8:35:40	2.15	6.5
300594	3008	5	12	8:27:04	8:30:42	8:34:15	3.633	3.55
300594	3009	5	15	8:27:07	8:28:58	8:32:54	1.85	3.933
300594	3010	5	15	8:27:54	8:32:54	8:34:01	5	1.117
300594	3011	5	12	8:28:01	8:28:25	8:30:42	0.4	2.283
300594	3013	5	15	8:28:08	8:34:01	8:35:31	5.883	1.5
300594	3014	8	22	8:28:11	8:29:15	8:42:32	1.067	13.283
300594	3015	8	19	8:28:14	8:30:34	8:42:36	2.333	12.033
300594	3016	5	16	8:28:17	8:35:40	8:40:43	7.383	5.05
300594	3017	1	5	8:28:21	8:36:02	9:06:05	7.683	30.05
300594	3018	5	12	8:28:24	8:37:31	8:38:25	9.117	0.9
300594	3019	5	15	8:28:27	8:37:00	8:44:21	8.55	7.35
300594	3020	5	12	8:28:30	8:41:54	8:43:11	13.4	1.283
300594	3023	5	12	8:28:48	8:38:25	8:40:08	9.617	1.717
300594	3024	5	15	8:28:55	8:35:31	8:37:00	6.6	1.483
300594	3026	4	11	8:30:09	8:31:38	8:34:59	1.483	3.35
300594	3027	5	16	8:30:23	8:40:43	8:45:28	10.333	4.75
300594	3029	5	12	8:31:05	8:40:08	8:41:54	9.05	1.767
300594	3030	5	16	8:31:49	8:45:28	8:53:34	13.65	8.1
300594	3031	3	10	8:31:54	8:32:56	8:36:41	1.033	3.75
300594	3031	4	11	8:36:41	8:50:37	8:52:47	13.933	2.167
300594	3032	5	14	8:31:57	8:40:30	8:43:53	8.55	3.383
300594	3035	5	12	8:33:12	8:43:11	8:48:09	9.983	4.967
300594	3036	1	2	8:33:24	8:34:38	8:41:28	1.233	6.833
300594	3036	4	11	8:41:28	8:52:47	8:54:13	11.316	1.433
300594	3037	5	14	8:33:28	8:43:53	8:46:01	10.416	2.133
300594	3038	5	15	8:33:32	8:44:21	8:47:18	10.816	2.95
300594	3040	5	14	8:33:47	8:48:51	8:50:16	15.066	1.417
300594	3040	5	16	8:50:16	8:53:34	8:54:28	3.3	0.9
300594	3040	6	17	8:54:28	8:54:39	8:59:47	0.183	5.133

The system we shall be using in our course



DataMOCCA

Data MOodels for Call Center Analisis

Project Partners:

Technion: Paul Feigin, Avi Mandelbaum, Sergey Zeltyn (IBM Research)

SEElab: Valery Trofimov, Ella Nadjharov, Igor Gavako

Students, RA's

Wharton: Larry Brown, Noah Gans, Haipeng Shen (N. Carolina), Linda Zhao

Students, Wharton Financial Institutions Center

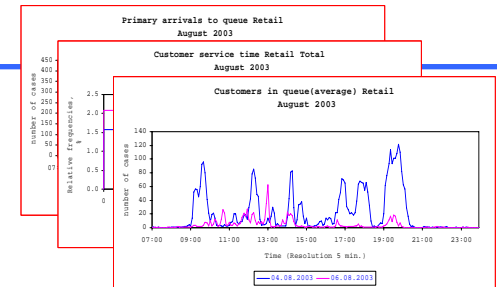
Companies: US Bank, IL Telecom (both Aspect-Based), IL Bank (Genesys), ...

System Components:

1. Clean databases: operational histories of **individual** calls, agents and sometimes customers (ID's).
2. **SEESat** (friendly powerful interface): online access to (mostly) operationa and (some) administrative data; flexible customization, statistics

Currently Three Databases:

- US Bank (220/40M calls, 1000 agents, 2.5 years;7-48GB; 3GB DVD).
- Israeli Telecom (800 agents, 3.5 years; 55GB; ongoing).
- Israeli Bank (500 agents, 1.5 years; ongoing).

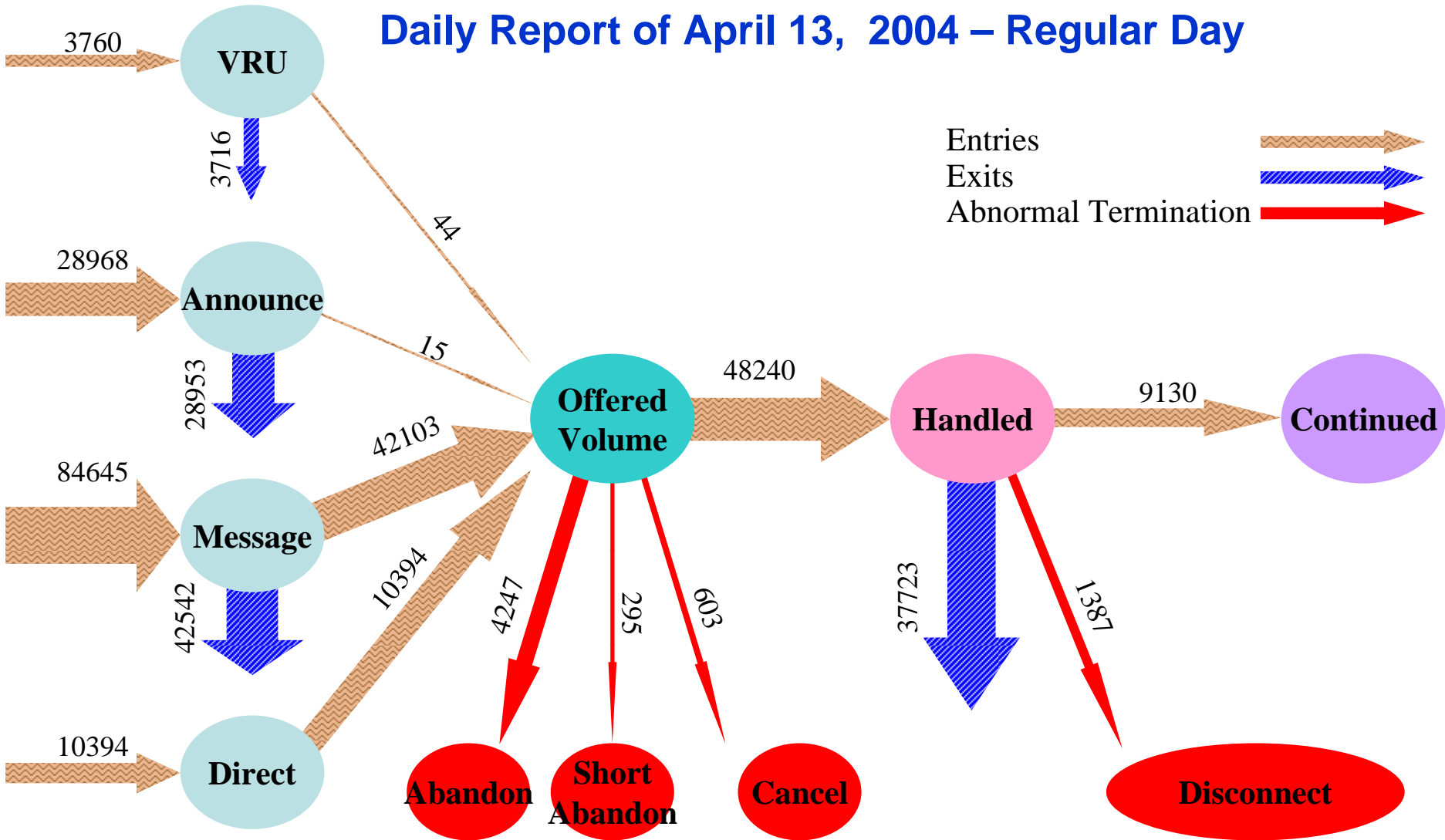


DataMOCCA Interface: SEEStat

- Daily / monthly / yearly reports & flow-charts for a complete operational view.
- Graphs and tables, in customized resolutions (month, days, hours, minutes, seconds) for a variety of (pre-designed) operational measures (arrival rates, abandonment counts, service- and wait-time distribution, utilization profiles,...).
- Graphs and tables for new user-defined measures.
- Direct access to the raw (cleaned) data: export, import.

DataMOCCA – SEESat

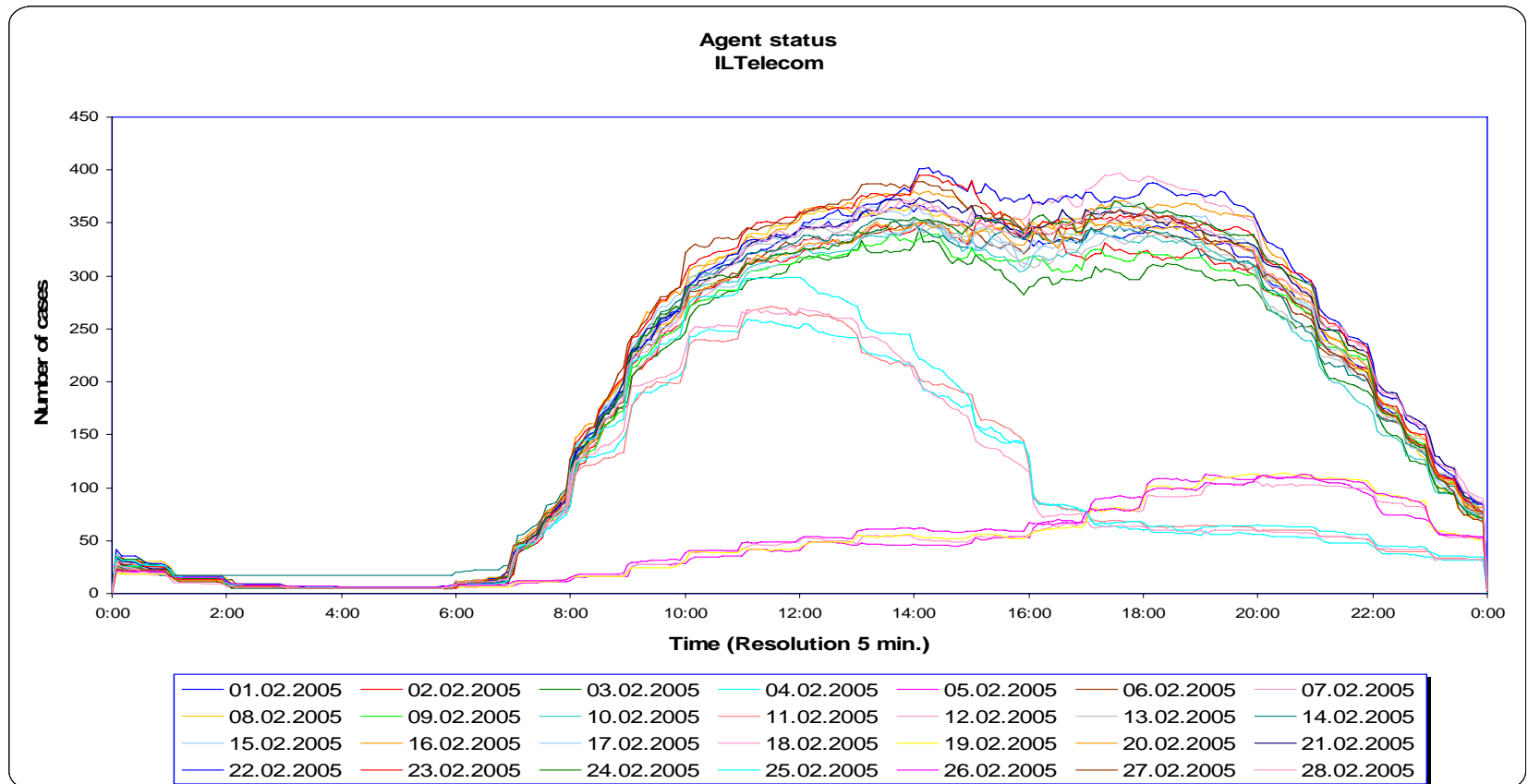
Daily Report of April 13, 2004 – Regular Day



DataMOCCA - SEESat

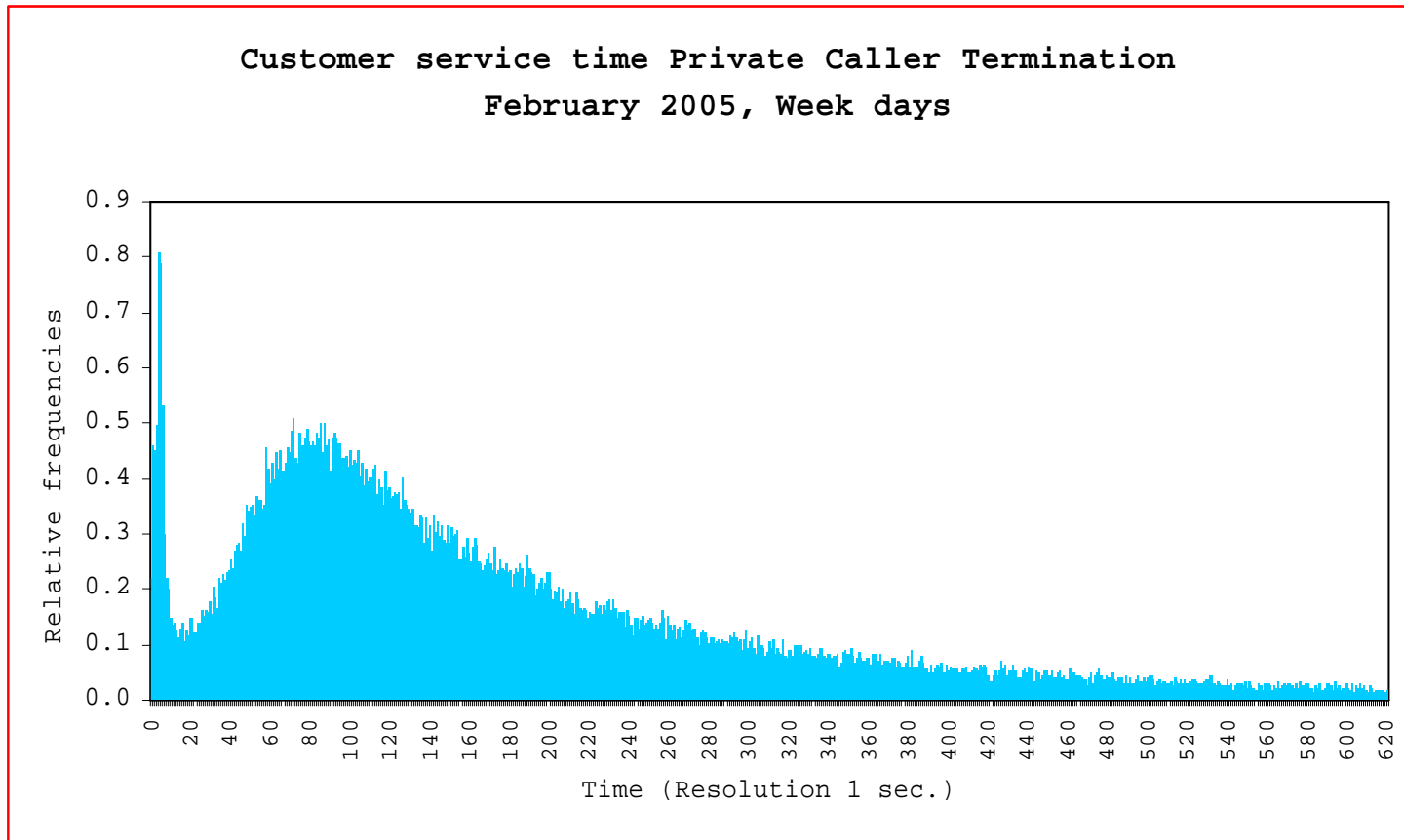
Pre-designed Operational Measures: Arrival Rates, 2/2005

Daily Reports



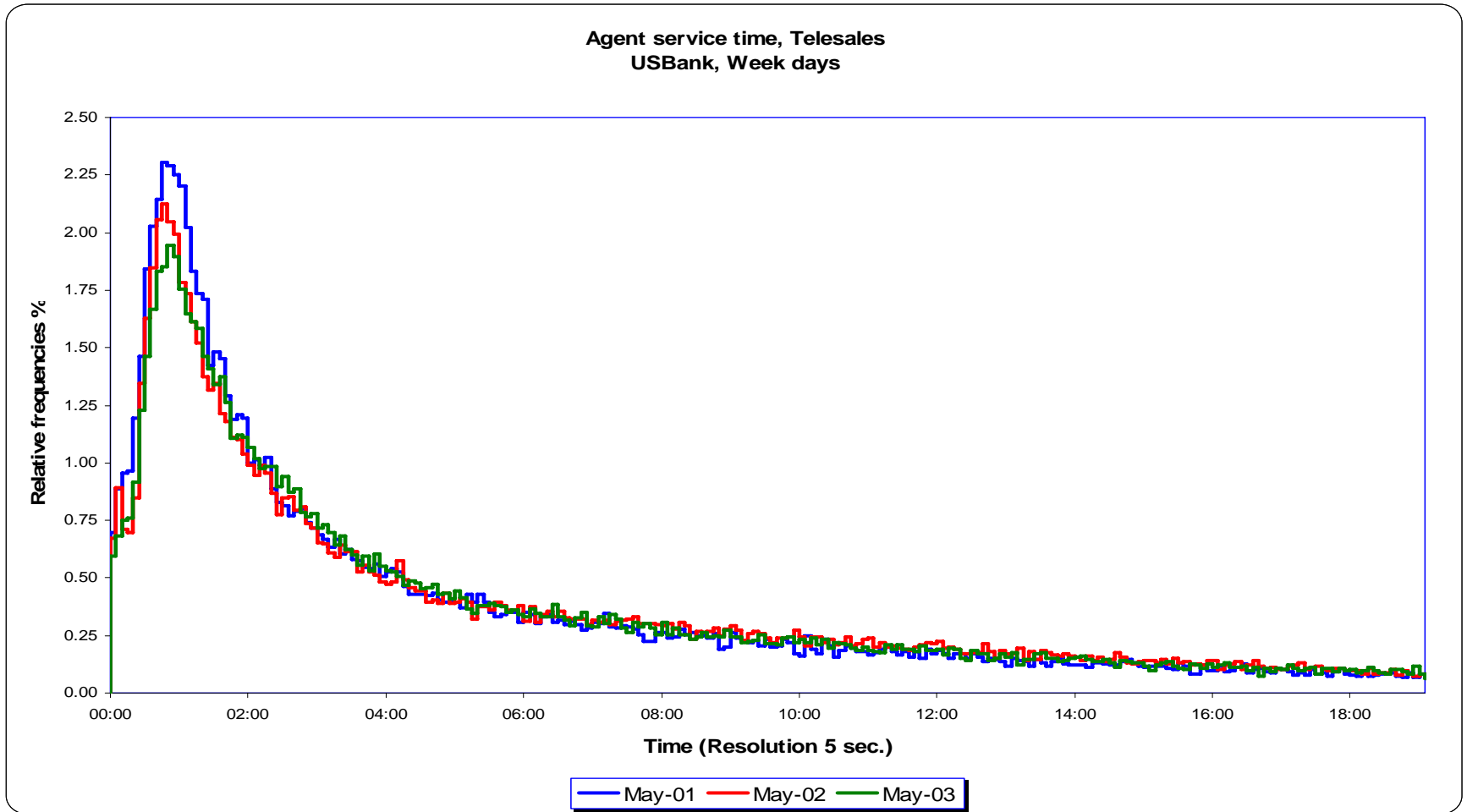
Data MOCCA - Interface

Pre-designed Operational Measures: Service Times Histograms

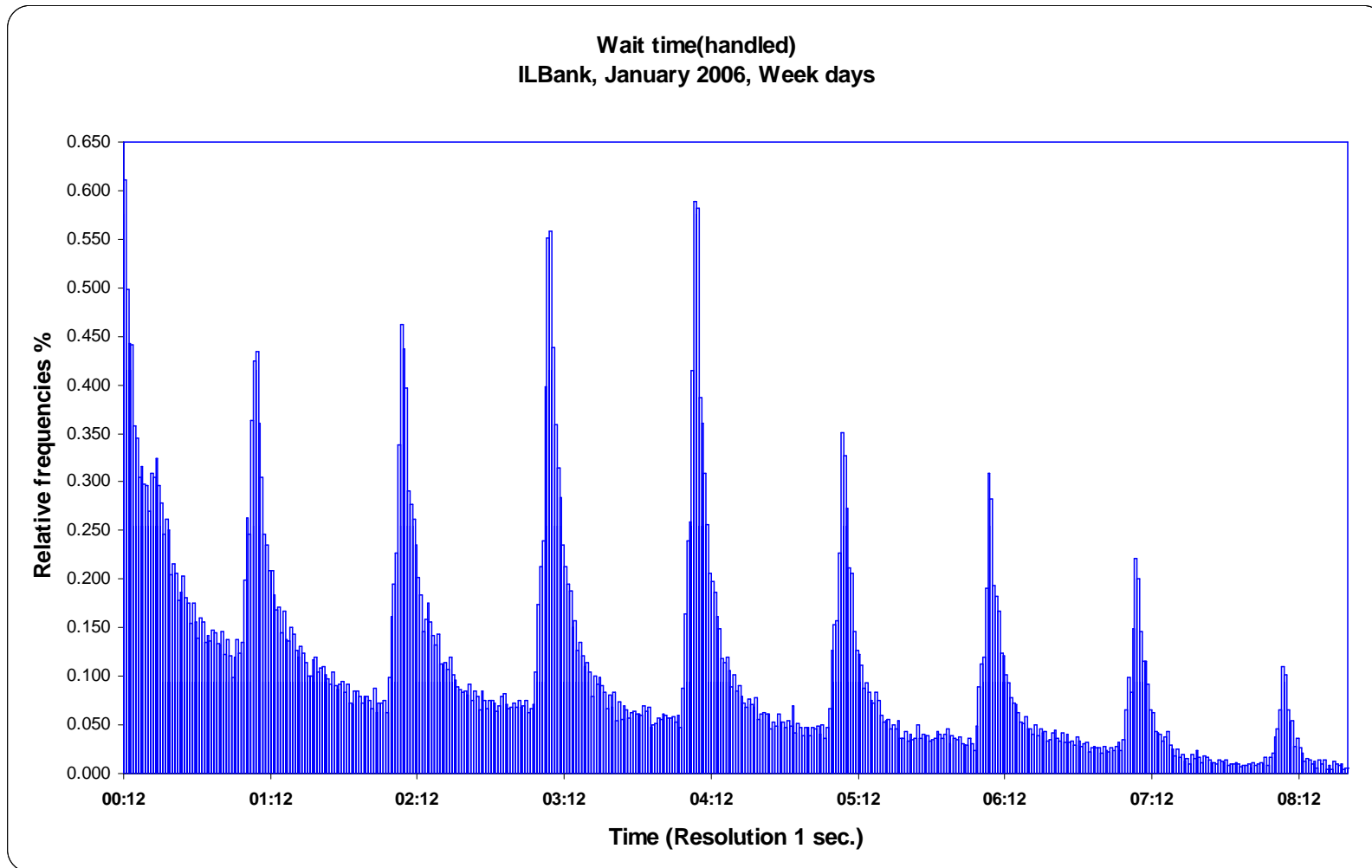


Interesting Scenarios: Service Science

US Bank: Service Time Histograms for Telesales, 2001-3

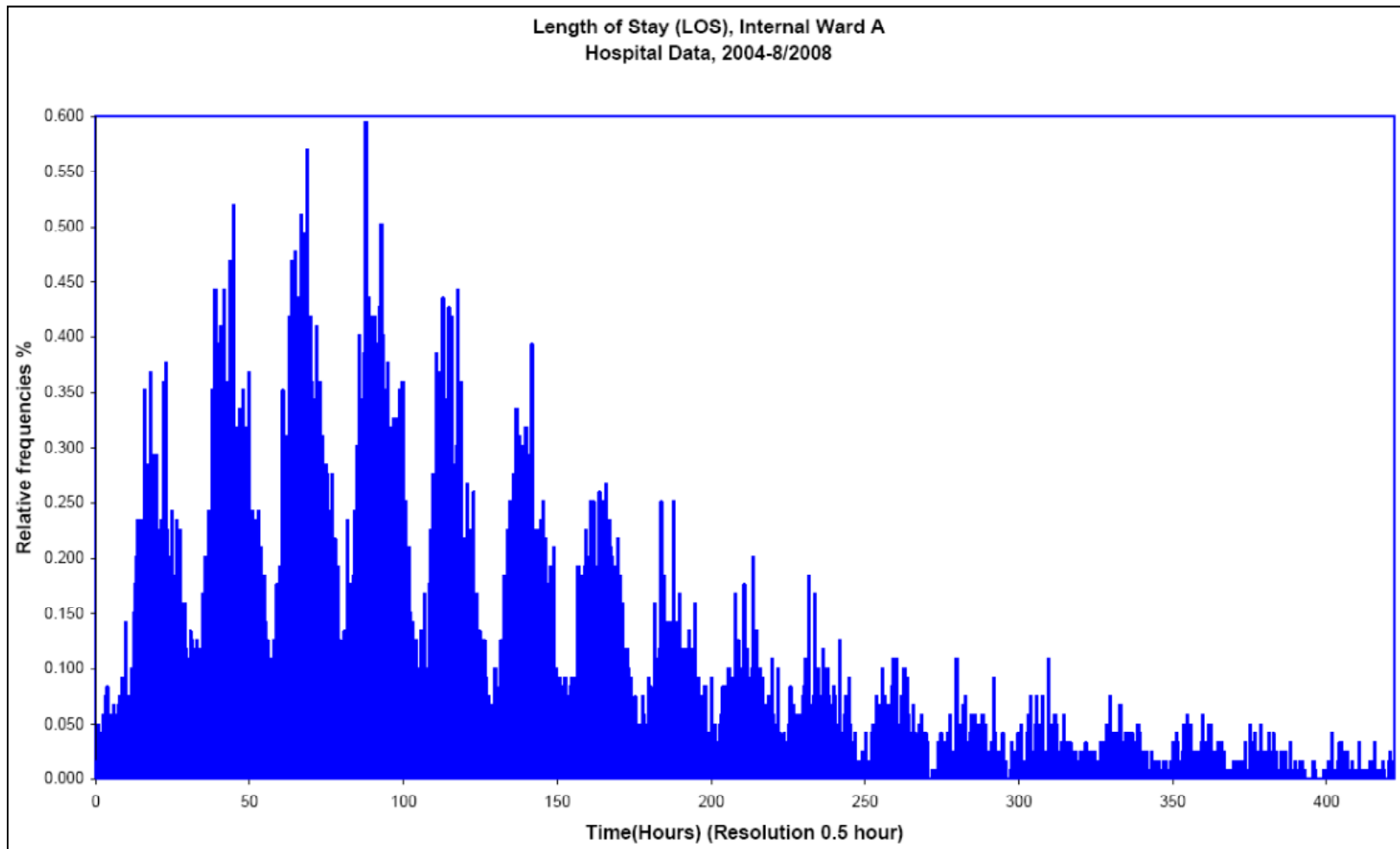


Israeli Bank: Histogram of **Waiting Time**



Explanations for the “strange” histogram shape will be provided during the course

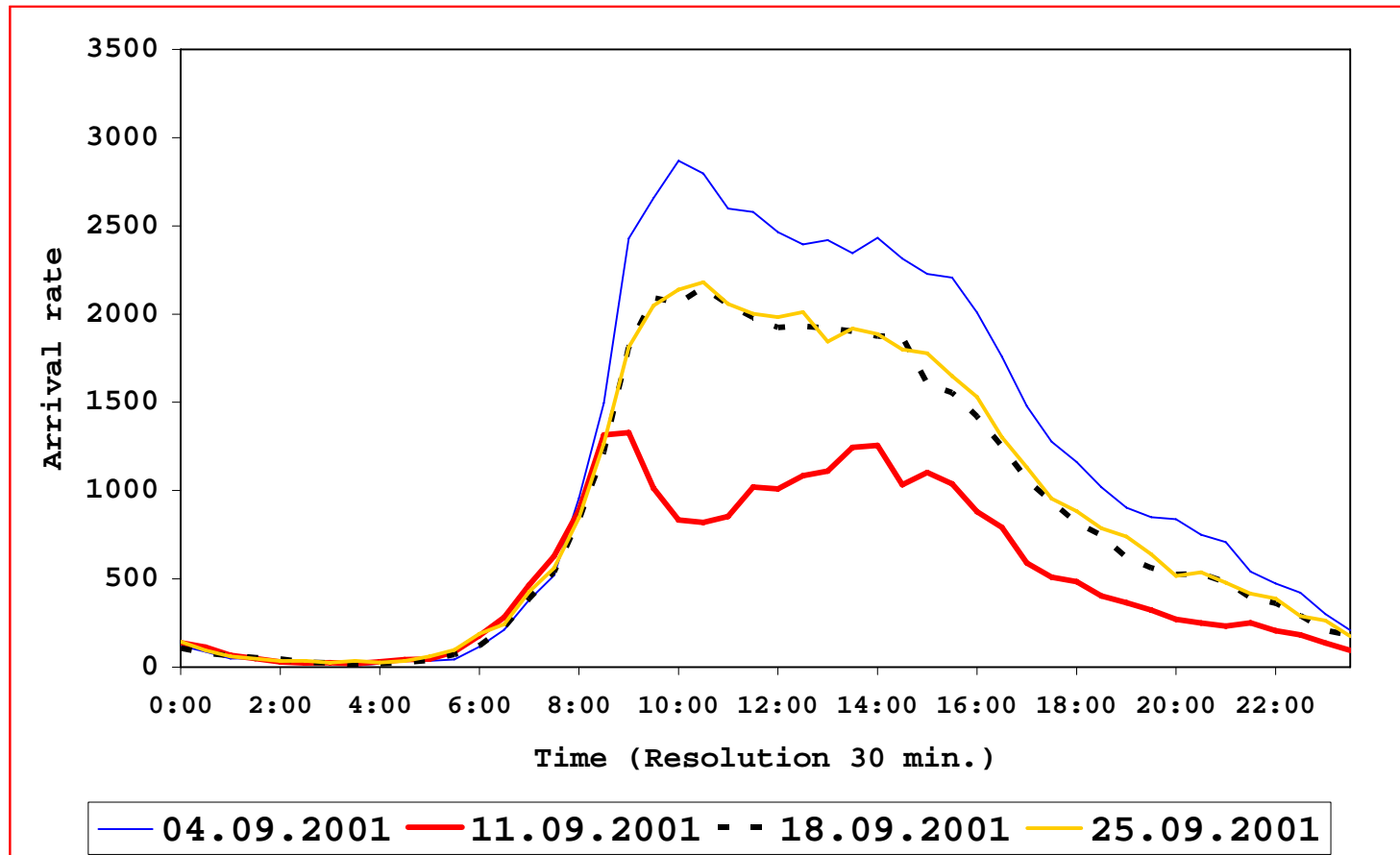
Hospital Data: Histogram of Length of Stay



Explanations for the “strange” histogram shape will be provided during the course

Data MOCCA – Interesting Scenarios

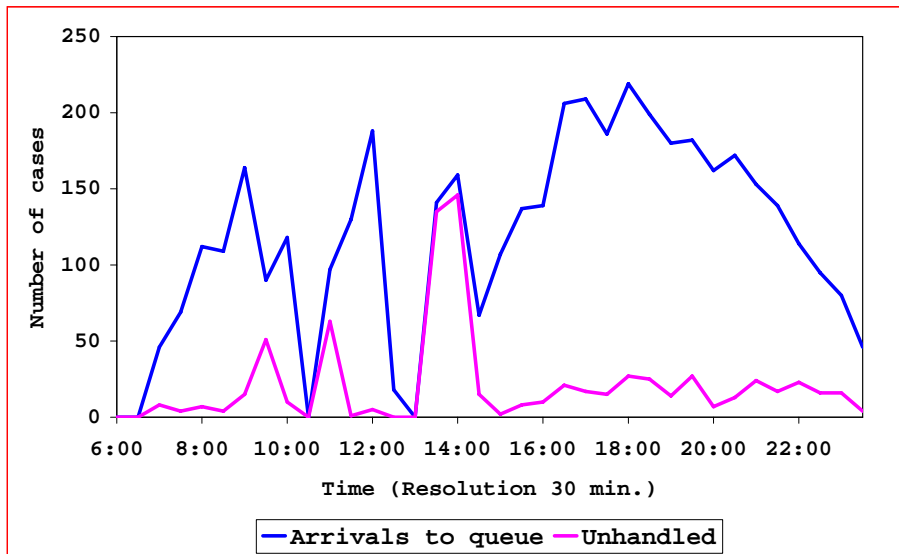
US Bank: Arrival Rates on Tuesdays in September



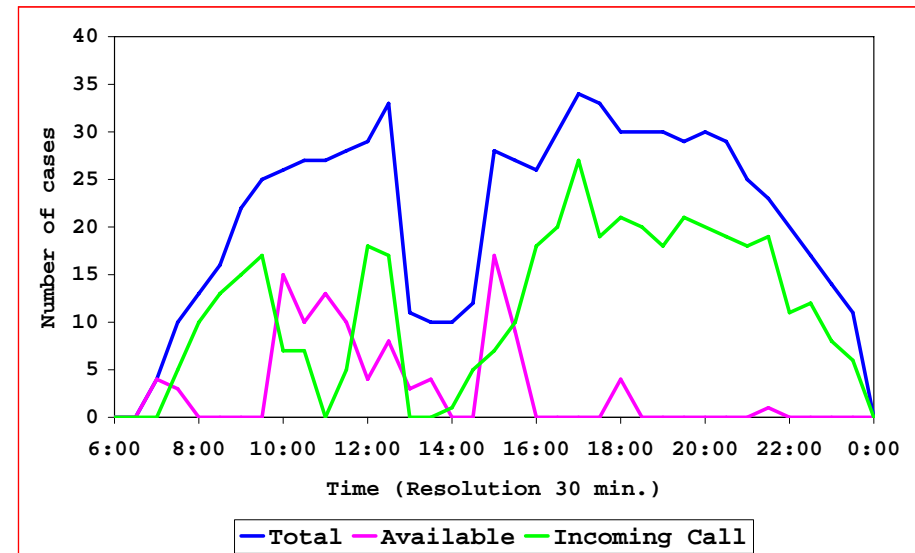
Data MOCCA – Interesting Scenarios

Israeli Call Center: Technical Service – Scenario Analysis

Unhandled Calls on May 24th, 2005

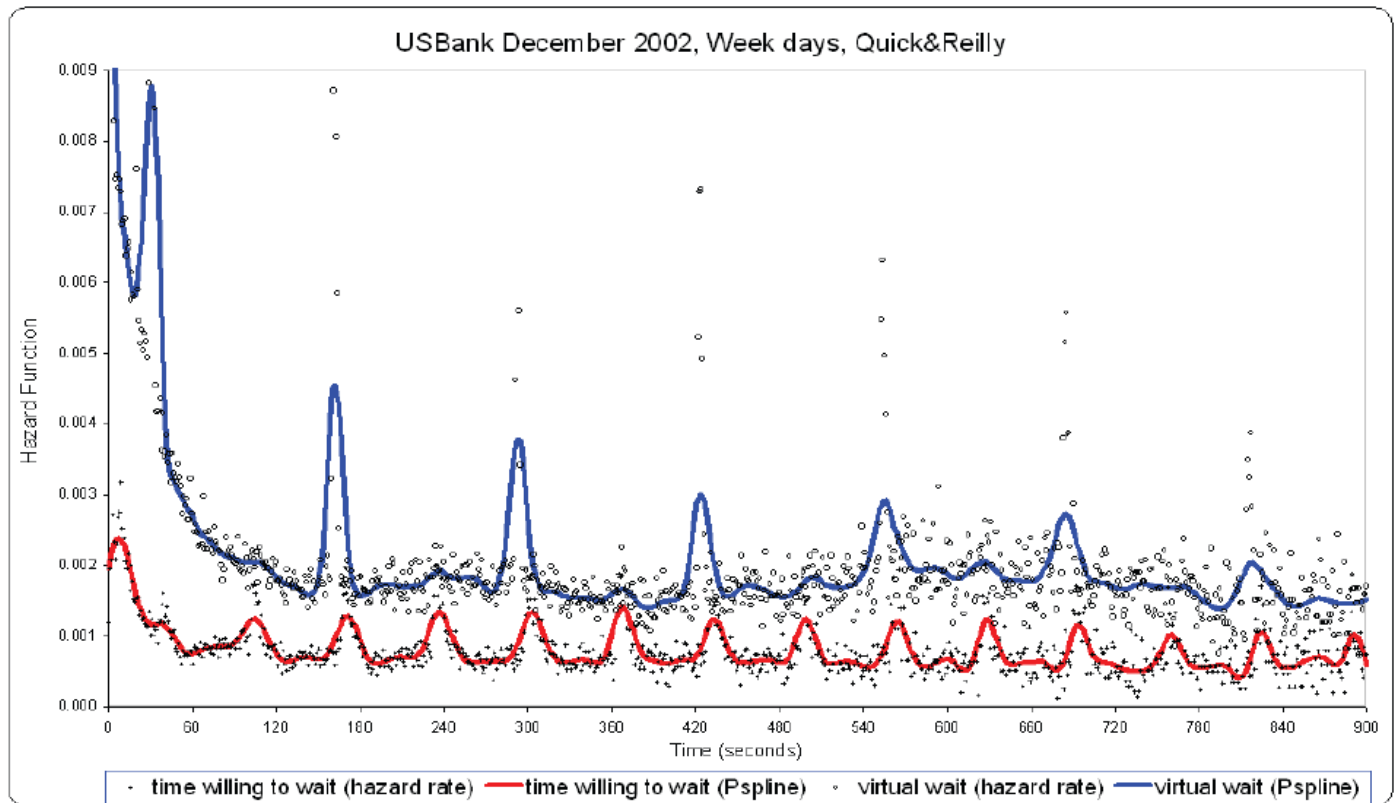


Agents Status on May 24th, 2005

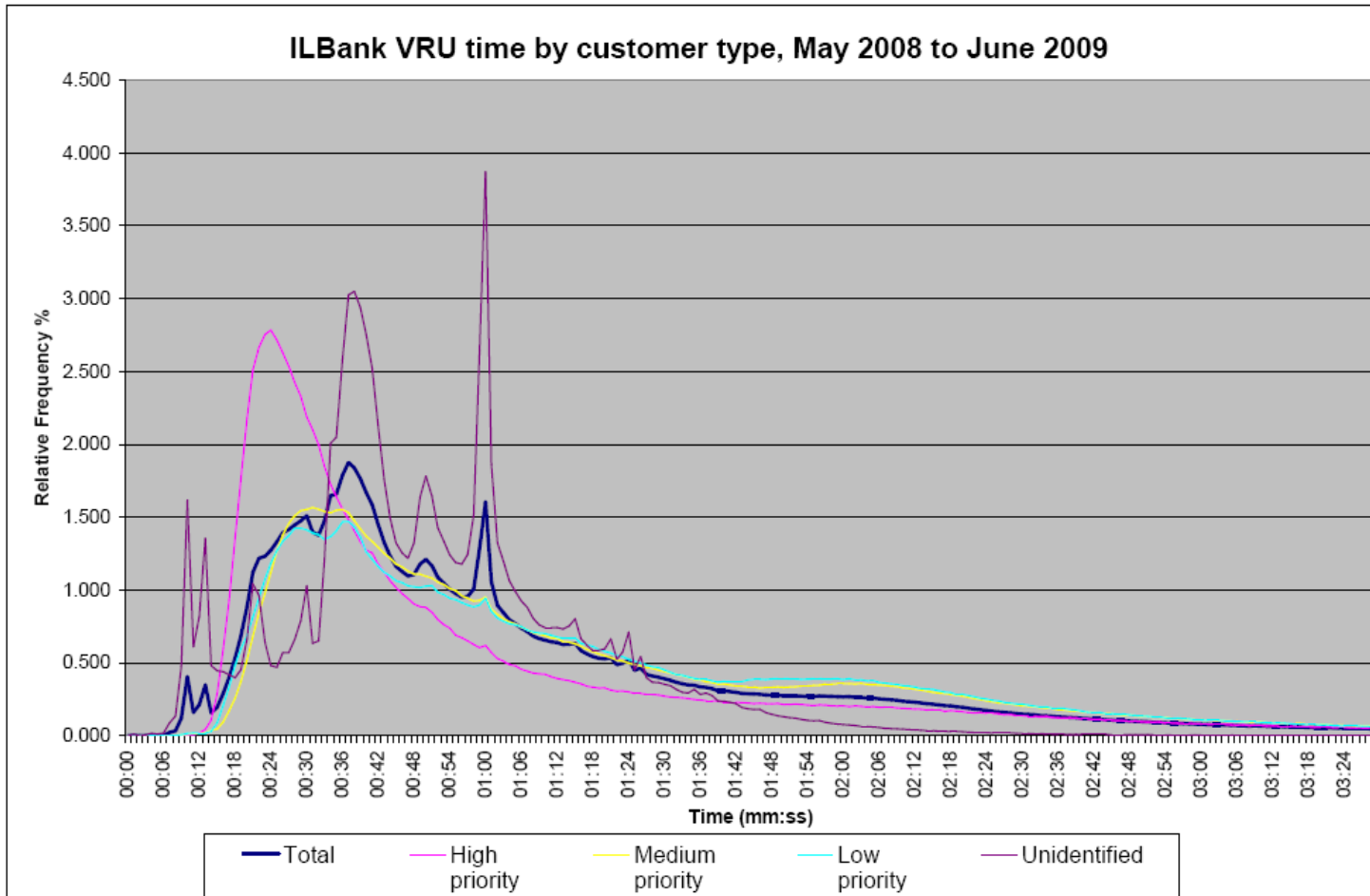


Analyzing Customers Patience – Hazard Rate

Psychology + Protocols



DataMOCCA - SEESat



Future features in SEESat – Daily report, customer flows within the IVR

