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The William Davidson Faculty of Industrial Engineering & Management



Center for Service Enterprise Engineering (SEE)
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HomeHospital (Rambam)

EDA via SEEStat 3.0

REPRODUCING “ON PATIENT FLOW IN HOSPITALS: A DATA-BASED QUEUEING-SCIENCE PERSPECTIVE”

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Contents

GENERAL REMARKS	2
1. INTRODUCTION	3
<i>Fig 2: The ED+IW sub-network</i>	<i>3</i>
3. EMERGENCY DEPARTMENT	4
3.2. EDA: TIME DEPENDENCY AND OVERDISPERSION.....	4
<i>Fig 3: Average number of patients and arrival rate by hour of the day</i>	<i>4</i>
3.3 EDA: FITTING A SIMPLE MODEL TO A COMPLEX REALITY	5
<i>Fig 4: Internal ED Occupancy histogram (left) and Average Census (right).....</i>	<i>5</i>
<i>by hour of the day</i>	<i>5</i>
<i>Fig 5(a): Fitting a mixture of three Normal distributions to the Empirical distribution of ED</i>	
<i>occupancy</i>	<i>7</i>
<i>Fig 5(b): Fitting a Normal distribution for a specific year, day of the week, and time of day.....</i>	<i>10</i>
3.4 EDA: STATE DEPENDENCY	11
<i>Fig 6: Service rate and service rate per patient as a function of number of the patients</i>	<i>11</i>
<i>Fig 7: Service rate per patient as a function of L by occupancy regime.....</i>	<i>13</i>
<i>Fig 8: Service rate as a function of $10 \leq L \leq 20$ (left), and Relative frequency (weight) of occupancy</i>	
<i>regime per L(right)</i>	<i>18</i>
4. INTERNAL WARDS	19
4.1. BASIC FACTS.....	19
<i>Table 1: Internal wards: operational profile</i>	<i>19</i>
4.2. EDA: LOS - A STORY OF MULTIPLE TIME SCALES	21
<i>Fig 9: LOS distribution of IW A in two time-scales: daily and hourly.....</i>	<i>21</i>
<i>Fig 10: Arrivals, departures, and average number of patients in Internal wards by hour of day</i>	<i>24</i>
4.3.3. DISECONOMIES OF SCALE (OR HOW WARD SIZE AFFECTS LOS).....	25
<i>Fig 11: Average LOS and number of patients in Internal wards B and D by year</i>	<i>25</i>
5. THE ED+IW NETWORK.....	32
5.2. DELAYS IN TRANSFER	32
<i>Fig 12: Transfer time by patient type, in hours.....</i>	<i>32</i>
5.3. INFLUENCE OF TRANSFER DELAYS ON THE ED	33
<i>Fig 13: Number of patients in ED-to-IW transfer (A-E) and the fraction of time that ED physicians</i>	
<i>devote to these patients</i>	<i>33</i>
5.6 A SYSTEM VIEW.....	35
<i>Fig 16: ED-to-IW boarding times and number of patients in IW.....</i>	<i>35</i>
<i>Fig 17: ALOS in IWs A through D, as a function of ward admission-time</i>	<i>39</i>
APPENDIX 1: NUMBER OF PATIENTS IN ED BY DAY-OF-WEEK.....	40
APPENDIX 2: ARRIVALS AND SERVICE RATES.....	41
2.1 SHORT DESCRIPTION	41
1.2 CALCULATIONS OVER PART OF DAY	45
APPENDIX 3: TIME BY ED STATE (SEC.) VARIABLE	49
3.1 DEFINITION OF THE VARIABLE	49
3.1.1 Simple calculation for a given dataset.....	49
3.1.1.1 Simple Example.....	49
3.1.1.2 Numerical Example: Surgery ED state.....	51
3.1.1.3 Numerical Example: Surgery and Internal ED state.....	55
3.1.2 Calculation for multiple units or one unit over multiple days.....	58

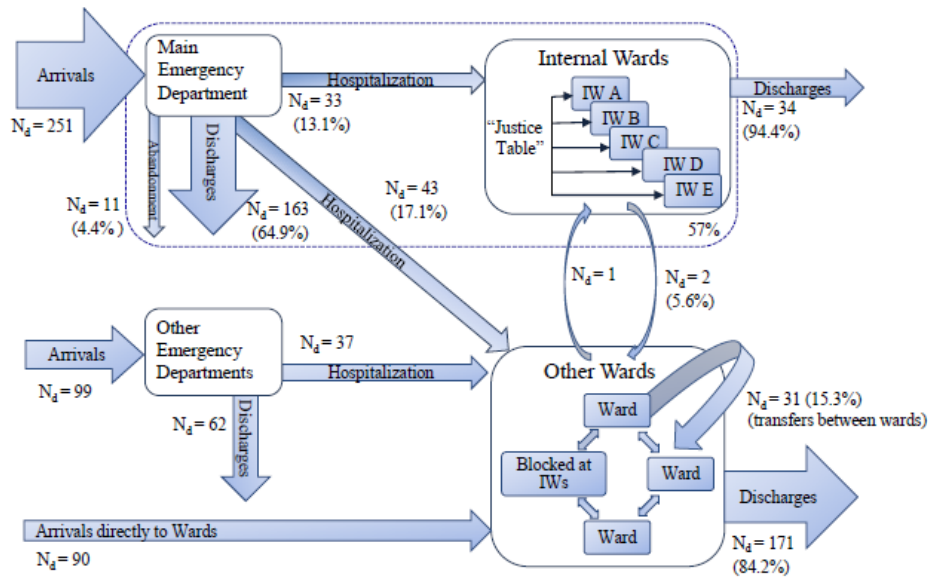
3.1.2.1 Simple Example (2 units at same time interval)	58
3.1.2.2 Numerical example: Surgery and Internal ED state (2 units over 1 day at same time).....	60
3.1.2.3 Numerical example: Internal ED state (1 unit over 2 days (Mondays) at same time)	65
3.1.2.4 Exercise (find out number of patients in 2 units over 1 day)	70
3.2 CREATION OF THE VARIABLE BY SEESTAT	72
3.2.1 <i>Calculating the number of patients during the day by “instants count” procedure</i>	72
3.2.2 <i>Creating ED state during the day on the basis of “instants count” procedure</i>	79
APPENDIX 4: HOW EXPORT DATA TABLE FROM SEESTAT.....	86
APPENDIX 5: HOW TO ADD A SECONDARY VERTICAL AXIS IN EXCEL	88
APPENDIX 6: CREATION OF SEESTAT USER EXTENSION	93
6.1 Register user folder	93
6.2 Add user extension	94
6.3 Create user database	95
APPENDIX 7: HOW TO TYPE FORMULA IN SEESTAT.....	96

General Remarks

Paper data period: **2004–2008** and SEELab data period: **2004–2007**

1. Introduction

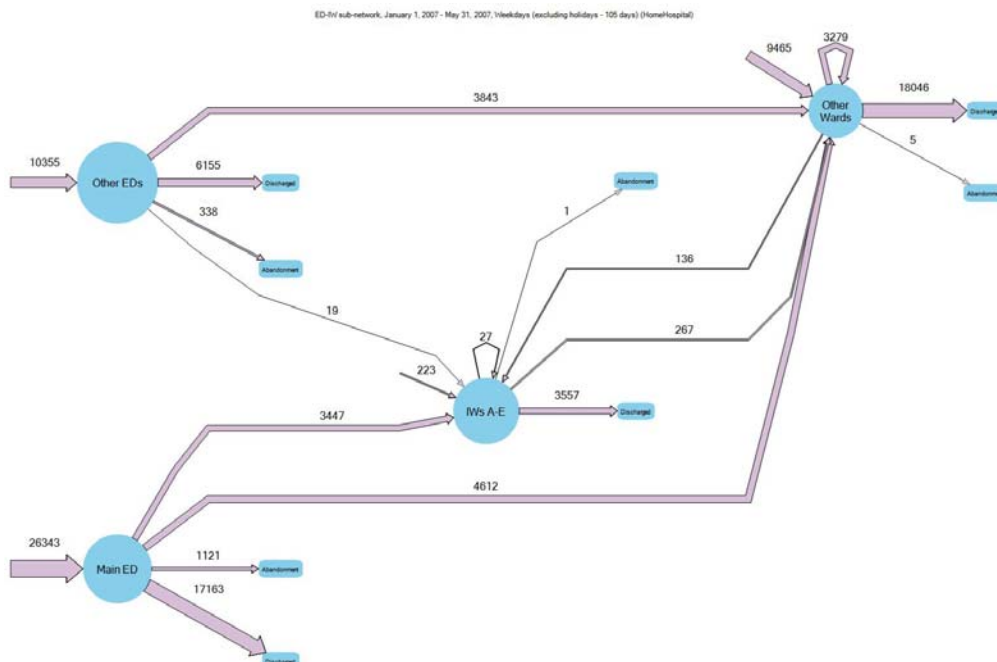
Fig 2: The ED+IW sub-network



N_d - daily average number of patients per normal weekdays (excluding holidays - 105 days), for period January 1, 2007 - May, 31, 2007
 main ED - Internal, Surgery, Traumatology, and Orthopedic EDs
 Blocked at IWs 3.54% of the ED patients - data from 2008 year

Figure 2 based on SEEGraph. Aggregate data from physical_details table, January 1, 2207 to May 31, 2007, 105 weekdays (excluding holidays)

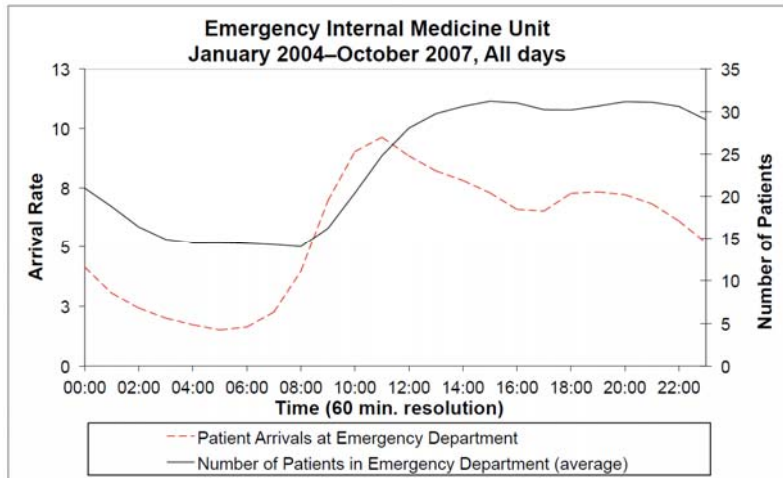
Original SEEGraph:



3. Emergency Department

3.2. EDA: Time dependency and overdispersion

Fig 3: Average number of patients and arrival rate by hour of the day

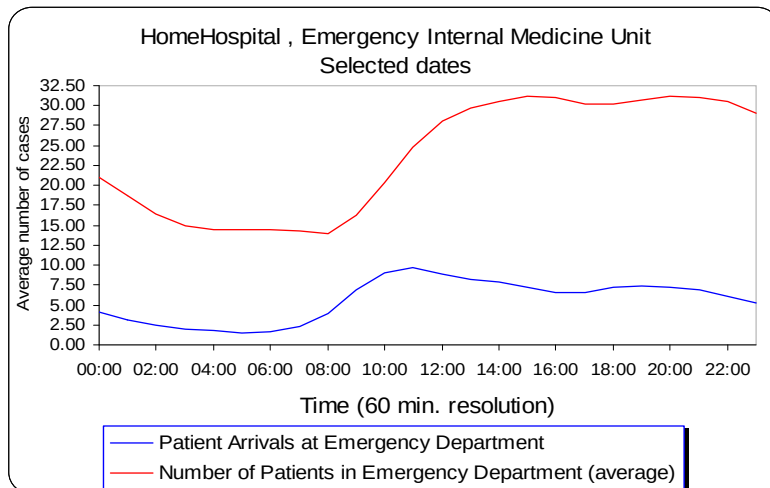


Reproducing steps:

1. Creating chart:

Click *Main* → *Statistical Models (Summaries)*. Select *Time Series*, then *Intraday*. From the variables list, select *Patient Arrivals at Emergency Department* and *Number of Patients in Emergency Department (average)*. In the *Select Categories* tab, select *Emergency Internal Medicine Unit*. Open the *X Properties* tab. Select resolution $60:00 = 1$ hour. Click the *Dates* → button. Select *Dates totals only* and all months from *January 2004* to *October 2007*. Open tab *Days* and select *All days*. Click *OK*.

Original SEEStat chart:

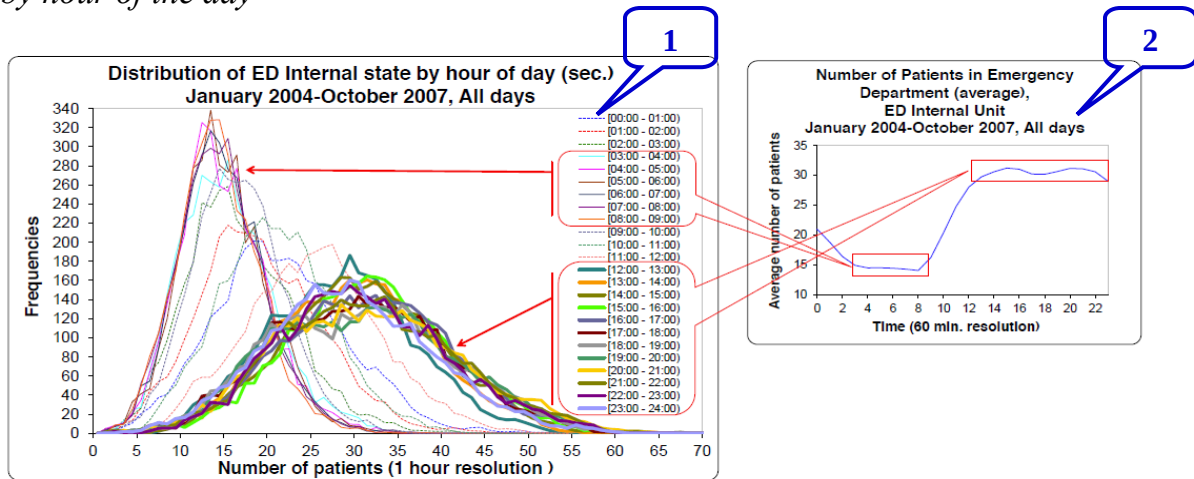


2. Design the original SEEStat chart:

Add and format secondary vertical axis for *Number of Patients in Emergency Department (average)*, format primary vertical axis. (see in [Appendix 5](#) How to add a secondary vertical axis in Excel). Change in the chart title *Selected dates* to *January 2004 – October 2007, All days*.

3.3 EDA: Fitting a simple model to a complex reality.

Fig 4: Internal ED Occupancy histogram (left) and Average Census (right) by hour of the day

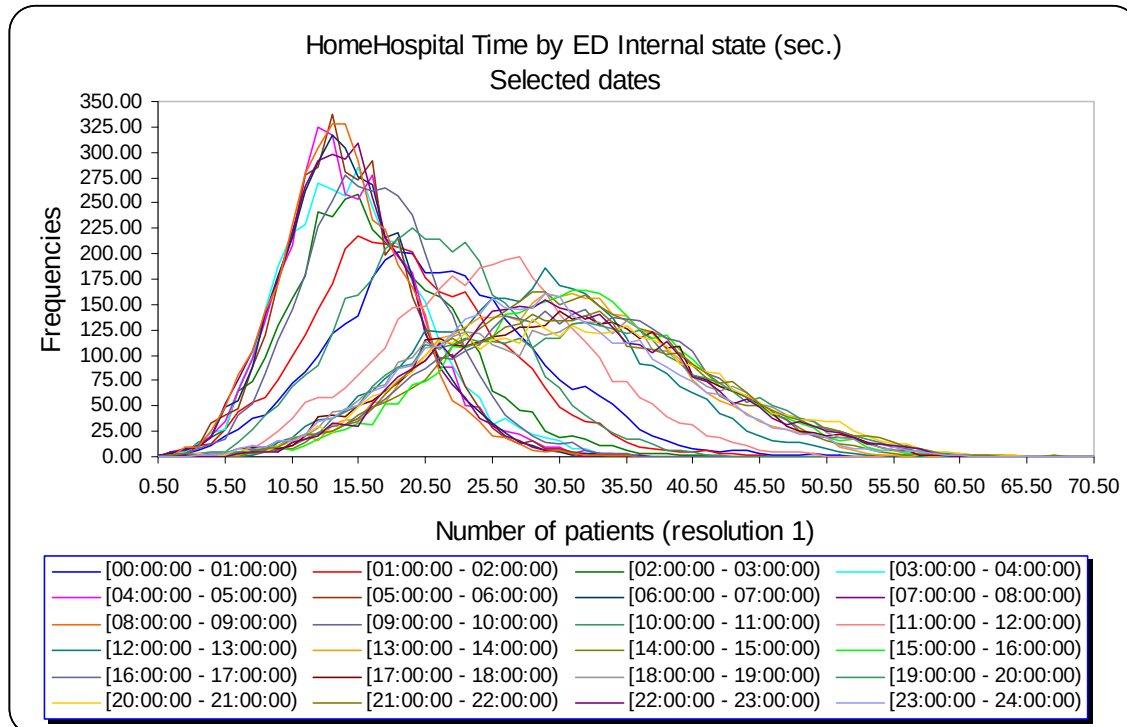


Reproducing steps for Time by ED Internal state (sec.) (1)

1. Creating chart:

Click *Main* → *Statistical Models (Summaries)*. Select *Distributions* → *Estimates*. From the variables list, select *Time by ED Internal state (sec.)*. On tab *Options* select *Convert to Frequencies* and chart type *Polygon*. In the *Select Categories* tab, select (with shift button) all categories except *Total*. Open the *X Properties* tab. Select resolution $I = 1$ patient. Select upper display range *100%*. Click the *Dates* → button. Select *Dates totals only* and all months from *January 2004* to *October 2007*. Open tab *Days* and select *All days*. Click *OK*.

Original SEESat chart:



2. Design the original SEEStat chart:

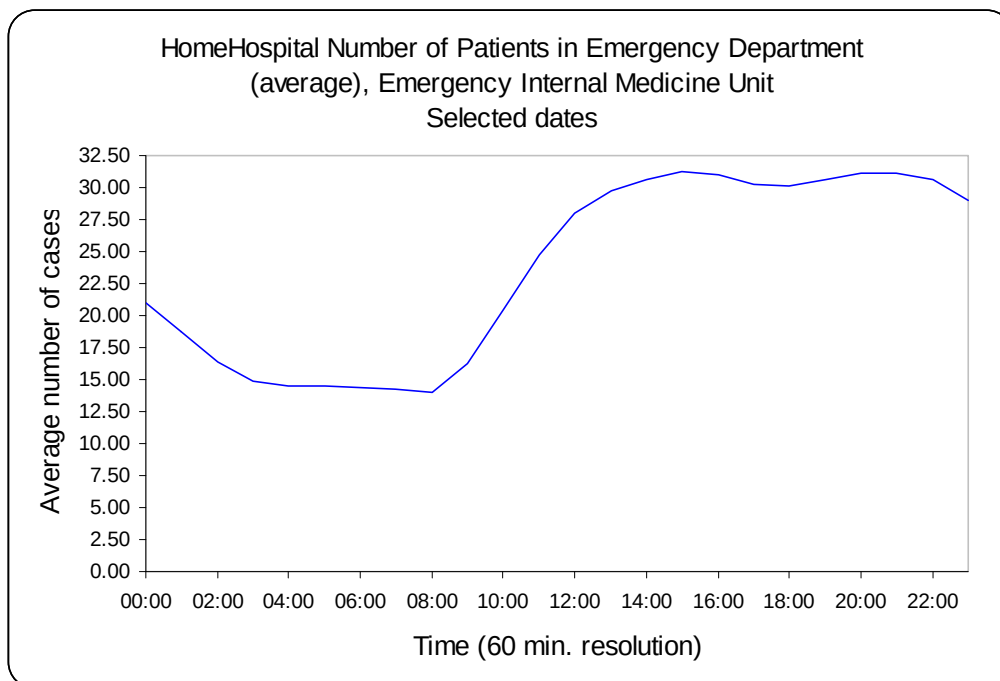
Change in the chart title *Selected dates* to *January 2004 – October 2007, All days*.
Format horizontal axis: set minimum 0, maximum 70, major unit 5, decimal places 0.
And format legend.

Reproducing steps for the Number of Patients in Emergency Department (average) (2)

1. Creating chart:

Click *Main* → *Statistical Models (Summaries)*. Select *Time Series*, then *Intraday*.
From the variables list, select *Number of Patients in Emergency Department (average)*. In the *Select Categories* tab, select *Emergency Internal Medicine Unit*. Open the *X Properties* tab. Select resolution *60:00 = 1 hour*. Click the *Dates* → button. Select *Dates totals only* and all months from *January 2004* to *October 2007*. Open tab *Days* and select *All days*. Click *OK*.

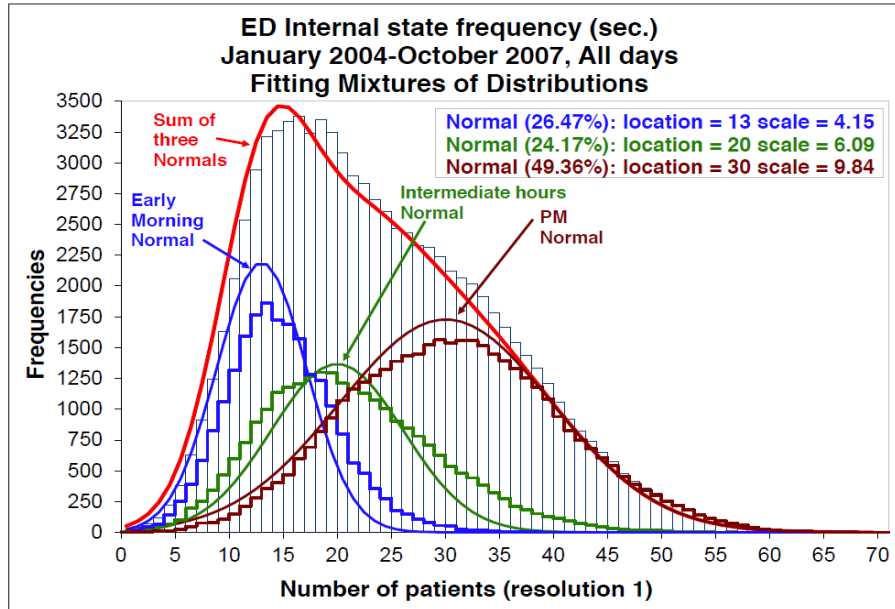
Original SEEStat chart:



2. Design the original SEEStat chart:

Change in the chart title *Selected dates* to *January 2004 – October 2007, All days*.
Format vertical axis: set minimum 10, maximum 35, major unit 5, decimal places 0.

Fig 5(a): Fitting a mixture of three Normal distributions to the Empirical distribution of ED occupancy

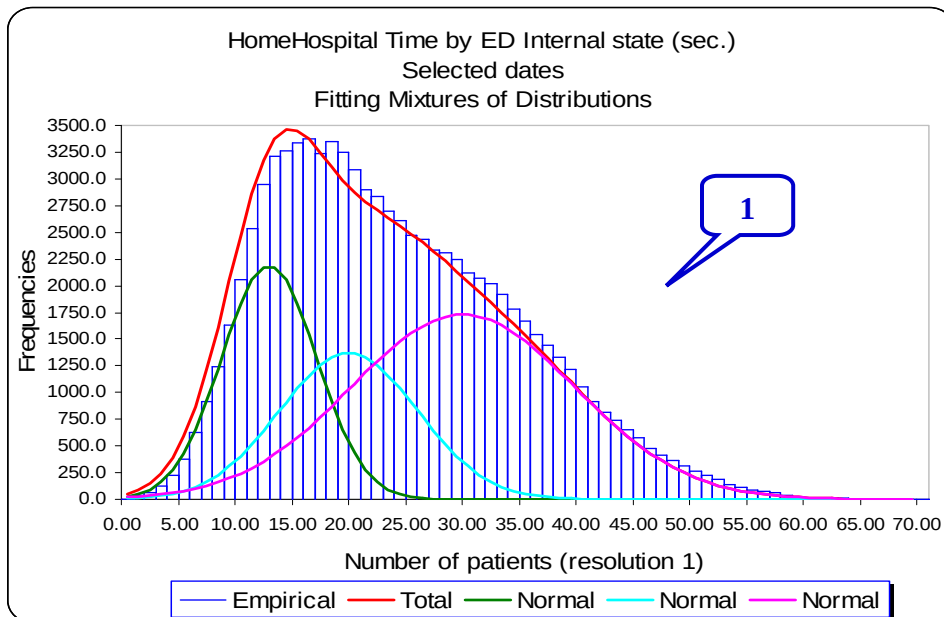


Reproducing steps for fitting mixtures of distributions

1. Creating chart:

Click *Main* → *Statistical Models (Summaries)*. Select *Distributions* → *Mixture Fitting*. From the variables list, select *Time by ED Internal state (sec.)*. On tab *Options* select *Convert to Frequencies* and 3 components of Normal distribution. In the *Select Categories* tab, select *Total*. Open the *X Properties* tab. Select resolution $1 = 1$ patient. Select upper display range *100%*. Click the *Dates* → button. Select *Dates totals only* and all months from *January 2004* to *October 2007*. Open tab *Days* and select *All days*. Click *OK*.

Original SEESat chart:



Original SEEStat table:

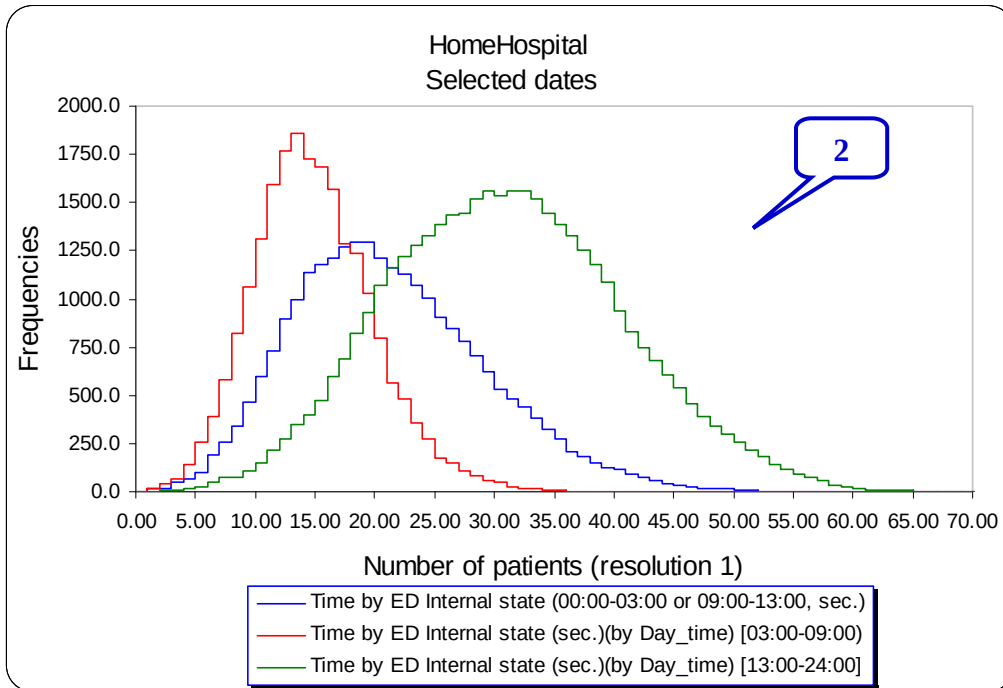
<i>Parameter Estimates</i>						
<i>Components</i>	<i>Mixing Proportions (%)</i>	<i>Location</i>	<i>Scale</i>	<i>Shape</i>	<i>Mean</i>	<i>Standard Deviation</i>
1. Normal	26.47	13.01	4.15		13.01	4.154397
2. Normal	24.17	20.00	6.09		20.00	6.085878
3. Normal	49.36	30.04	9.84		30.04	9.837746

Reproducing steps for fitting distributions

2. Creating chart:

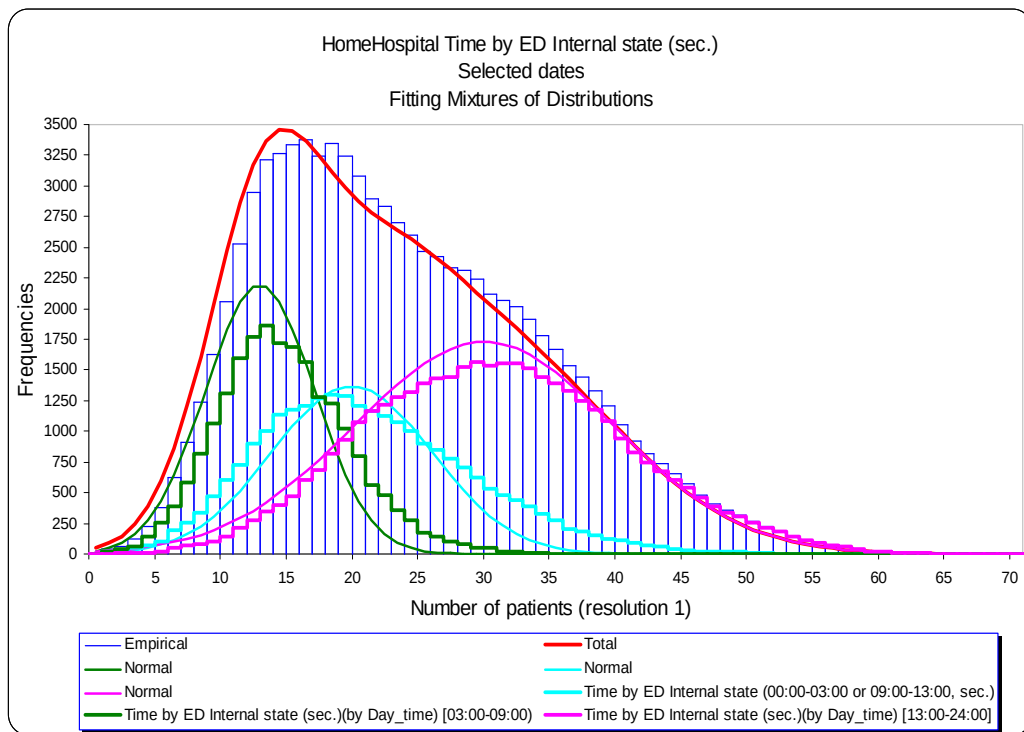
Click *New Model* → *Distributions* → *Estimates*. From the variables list, select *Time by ED Internal state (sec.)(by Day_time)* and *Time by ED Internal state (00:00-03:00 or 09:00-13:00, sec.)*. On tab *Options* select *Convert to Frequencies* and chart type *Histogram*. In the *Select Categories* tab, select *03:00-09:00* and *13:00-24:00*. Open the *X Properties* tab. Select resolution *I = 1* patient. Select upper display range *100%*. Click the *Dates* → button. Select *Dates totals only* and all months from *January 2004* to *October 2007*. Open tab *Days* and select *All days*. Click *OK*.

Original SEEStat chart:



3. Combine fitted distribution (1) with empirical distribution (2)

Add series from chart (2): *Time by ED Internal state (00:00-03:00 or 09:00-13:00, sec.)*, *Time by ED Internal state (sec.)(by Day_time) [03:00-09:00]* and *Time by ED Internal state (sec.)(by Day_time) [13:00-24:00]* to chart (1).

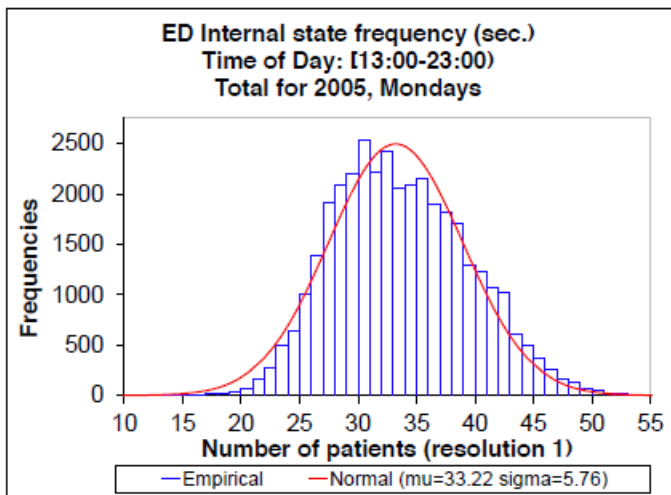


4. Design the original SEEStat chart:

Change in the chart title *Selected dates* to *January 2004 – October 2007, All days*.

Format vertical axis: decimal places 0.

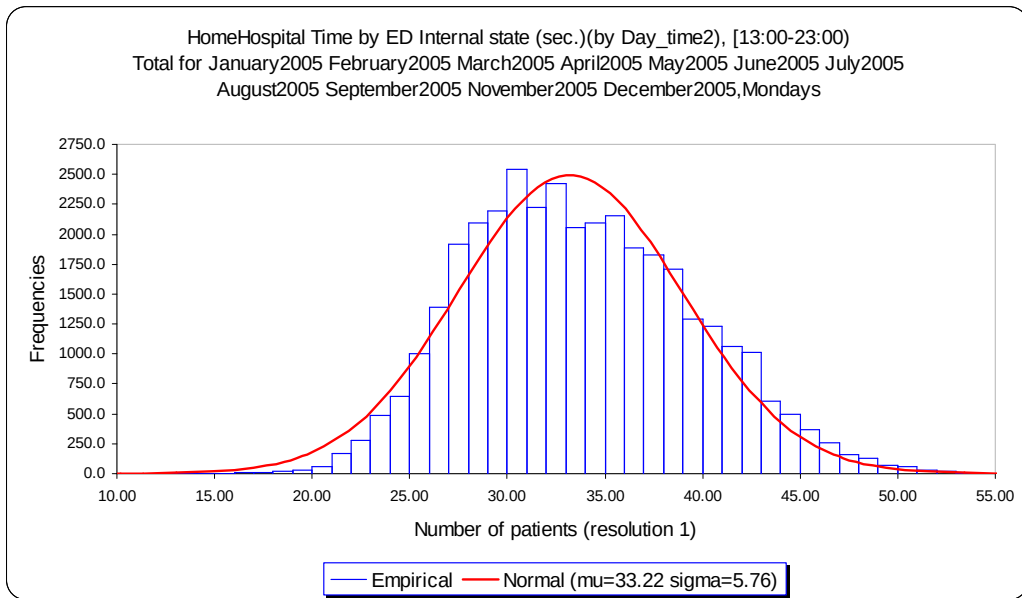
Fig 5(b): Fitting a Normal distribution for a specific year, day of the week, and time of day



Reproducing steps for fitting distribution

Click *Main* → *Statistical Models (Summaries)*. Select *Distributions* → *Fitting*. From the variables list, select *Time by ED Internal state (sec.)(by Day_time2)*. On tab *Options* select *Convert to Frequencies* and *Normal* distribution. In the *Select Categories* tab, select *[13:00-23:00)*. Open the *X Properties* tab. Select resolution *1 = 1 patient*. In *range to Display* options select low limit = *10* (10 patients) and upper display range *100%*. Click the *Dates* → button. Select *Dates totals only* and months from *January 2005* to *December 2005* excluding *October 2005*. Open tab *Days* and select *Mondays*. Click *OK*.

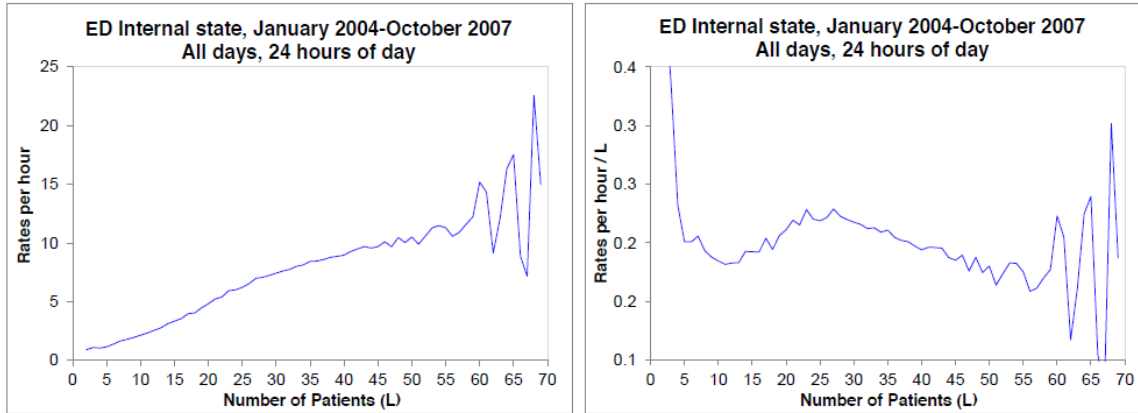
Original SEESat chart:



3.4 EDA: State dependency

Fig 6: Service rate and service rate per patient as a function of number of the patients

SEE DETAILS IN [APPENDIX 2](#).

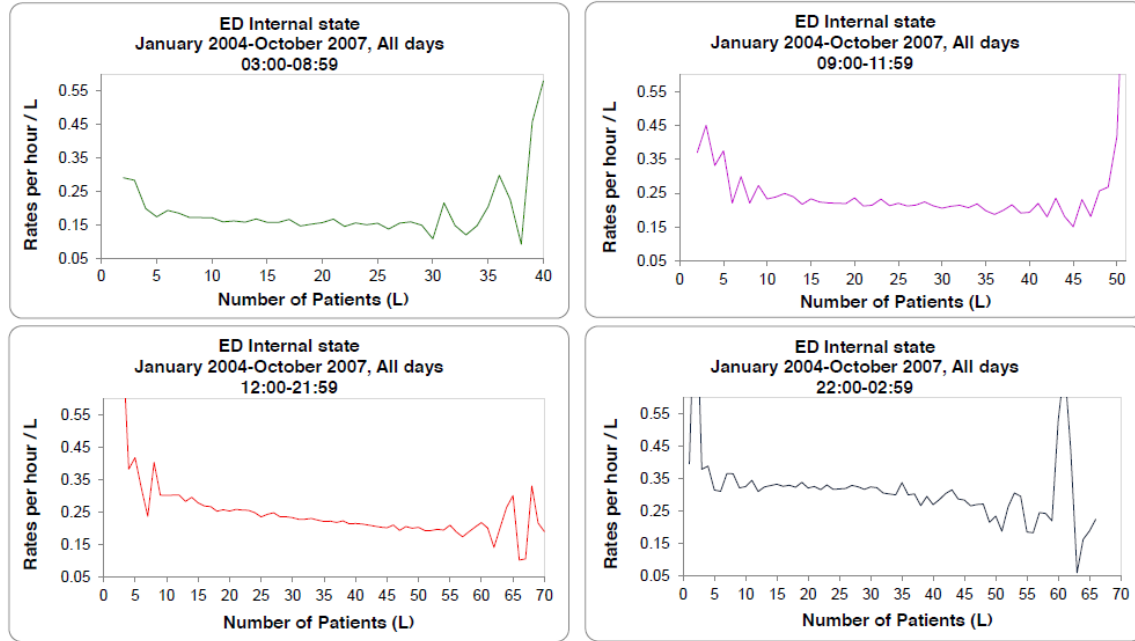


Internal ED, January 2004 - October 2007, all days, over 24 hours of day				
ED state (number of patients) L	Departures, total over all period $\sum_1^n D_i$	ED state duration in hours, total over all period $\sum_1^n T_i$	Service rate per hour (daily weighted average) μ_i	Service rate per hour/L μ_i / L
0	0	0.48		
1	2	15.07	0.13	0.133
2	23	25.56	0.90	0.450
3	51	46.41	1.10	0.366
4	91	86.74	1.05	0.262
5	170	147.29	1.15	0.231
6	335	241.86	1.39	0.231
7	585	354.40	1.65	0.236
8	856	479.19	1.79	0.223
9	1237	631.13	1.96	0.218
10	1717	800.26	2.15	0.215
11	2290	983.48	2.33	0.212
12	2913	1140.24	2.55	0.213
13	3434	1239.40	2.77	0.213
14	3965	1271.26	3.12	0.223
15	4336	1299.57	3.34	0.222
16	4666	1311.82	3.56	0.222
17	4996	1256.59	3.98	0.234
18	5255	1300.45	4.04	0.224
19	5690	1268.07	4.49	0.236
20	5756	1193.14	4.82	0.241
21	5895	1125.88	5.24	0.249
22	5929	1098.36	5.40	0.245
23	6246	1051.17	5.94	0.258
24	6084	1012.78	6.01	0.250
25	6025	968.54	6.22	0.249
26	6198	947.36	6.54	0.252
27	6342	907.15	6.99	0.259
28	6324	893.62	7.08	0.253
29	6333	873.99	7.25	0.250
30	6119	823.70	7.43	0.248
31	6161	808.70	7.62	0.246
32	6073	783.64	7.75	0.242

33	5996	747.95	8.02	0.243
34	5652	695.00	8.13	0.239
35	5470	648.70	8.43	0.241
36	5066	599.18	8.45	0.235
37	4788	557.43	8.59	0.232
38	4588	522.62	8.78	0.231
39	4166	470.01	8.86	0.227
40	3710	413.97	8.96	0.224
41	3321	358.01	9.28	0.226
42	3039	320.07	9.49	0.226
43	2796	288.37	9.70	0.225
44	2446	255.55	9.57	0.218
45	2169	223.90	9.69	0.215
46	1883	186.44	10.10	0.220
47	1562	161.37	9.68	0.206
48	1477	141.28	10.45	0.218
49	1248	124.41	10.03	0.205
50	1076	102.37	10.51	0.210
51	860	86.91	9.90	0.194
52	766	72.29	10.60	0.204
53	629	55.73	11.29	0.213
54	518	45.14	11.48	0.213
55	406	35.94	11.30	0.205
56	302	28.59	10.56	0.189
57	258	23.65	10.91	0.191
58	171	14.75	11.60	0.200
59	125	10.22	12.23	0.207
60	101	6.65	15.18	0.253
61	71	4.96	14.33	0.235
62	41	4.48	9.14	0.147
63	35	2.90	12.06	0.191
64	29	1.78	16.31	0.255
65	10	0.57	17.52	0.270
66	7	0.79	8.89	0.135
67	4	0.56	7.17	0.107
68	2	0.09	22.57	0.332
69	1	0.07	15.00	0.217
70	1	0.07	13.38	0.191

Fig 7: Service rate per patient as a function of L by occupancy regime

SEE DETAILS IN [APPENDIX 2](#).



Internal ED, January 2004 - October 2007, all days, over 6 hours of day, from 03:00:00 to 08:59:59					
ED state (number of patients) L	Departures, total over all period $\sum_i D_i$	ED state duration in hours, total over all period $\sum_i T_i$	Service rate per hour (daily weighted average) μ_i	Service rate per hour/L μ_i / L	
1	0	7.89	0.00	0.000	
2	10	17.18	0.58	0.291	
3	21	24.68	0.85	0.284	
4	44	55.25	0.80	0.199	
5	86	98.68	0.87	0.174	
6	173	149.15	1.16	0.193	
7	293	225.92	1.30	0.185	
8	436	317.00	1.38	0.172	
9	634	409.60	1.55	0.172	
10	877	511.20	1.72	0.172	
11	1083	618.36	1.75	0.159	
12	1331	684.93	1.94	0.162	
13	1473	716.02	2.06	0.158	
14	1584	674.03	2.35	0.168	
15	1554	656.59	2.37	0.158	
16	1540	612.33	2.51	0.157	
17	1407	497.55	2.83	0.166	
18	1267	479.57	2.64	0.147	
19	1164	402.51	2.89	0.152	
20	978	311.77	3.14	0.157	
21	780	221.72	3.52	0.168	
22	598	187.13	3.20	0.145	
23	503	140.13	3.59	0.156	
24	385	106.55	3.61	0.151	
25	279	72.02	3.87	0.155	
26	205	57.23	3.58	0.138	
27	172	40.98	4.20	0.155	
28	140	31.41	4.46	0.159	
29	94	21.73	4.33	0.149	

30	65	19.95	3.26	0.109
31	60	8.96	6.69	0.216
32	38	8.01	4.74	0.148
33	22	5.54	3.97	0.120
34	21	4.18	5.03	0.148
35	14	1.95	7.17	0.205
36	10	0.93	10.74	0.298
37	5	0.60	8.34	0.225
38	2	0.57	3.52	0.093
39	2	0.11	17.87	0.458
40	2	0.09	23.23	0.581

Internal ED, January 2004 - October 2007, all days, over 3 hours of day, from 09:00:00 to 11:59:59				
ED state (number of patients) L	Departures, total over all period $\sum_i D_i$	ED state duration in hours, total over all period $\sum_i t_i$	Service rate per hour (daily weighted average) μ_i	Service rate per hour/L μ_i / L
1	0	1.56	0.00	0.000
2	2	2.70	0.74	0.371
3	7	5.18	1.35	0.450
4	11	8.28	1.33	0.332
5	18	9.59	1.88	0.375
6	30	22.58	1.33	0.221
7	70	33.40	2.10	0.299
8	96	54.20	1.77	0.221
9	182	74.02	2.46	0.273
10	226	96.82	2.33	0.233
11	323	122.82	2.63	0.239
12	435	145.28	2.99	0.250
13	518	166.28	3.12	0.240
14	593	194.87	3.04	0.217
15	691	197.05	3.51	0.234
16	746	207.79	3.59	0.224
17	845	224.34	3.77	0.222
18	929	233.67	3.98	0.221
19	1002	239.68	4.18	0.220
20	1033	218.57	4.73	0.236
21	939	210.44	4.46	0.212
22	954	201.99	4.72	0.215
23	1010	188.50	5.36	0.233
24	922	179.80	5.13	0.214
25	880	159.50	5.52	0.221
26	827	149.61	5.53	0.213
27	833	143.27	5.81	0.215
28	746	118.56	6.29	0.225
29	619	100.15	6.18	0.213
30	528	85.38	6.18	0.206
31	487	74.22	6.56	0.212
32	432	62.80	6.88	0.215
33	353	51.51	6.85	0.208
34	295	39.66	7.44	0.219
35	260	37.41	6.95	0.199
36	200	29.57	6.76	0.188
37	189	25.55	7.40	0.200
38	146	17.76	8.22	0.216
39	116	15.52	7.47	0.192
40	106	13.65	7.77	0.194
41	82	9.08	9.03	0.220
42	58	7.63	7.60	0.181
43	61	6.02	10.13	0.236
44	35	4.37	8.01	0.182
45	17	2.49	6.83	0.152
46	20	1.88	10.64	0.231
47	16	1.87	8.55	0.182
48	19	1.54	12.35	0.257
49	14	1.06	13.17	0.269

50	6	0.29	20.85	0.417
51	4	0.08	52.94	1.038
52	0	0.03	0.00	0.000
53	0	0.13	0.00	0.000

Internal ED, January 2004 - October 2007, all days, over 10 hours of day, from 12:00:00 to 21:59:59				
ED state (number of patients) L	Departures, total over all period $\sum_i D_i$	ED state duration in hours, total over all period $\sum_i T_i$	Service rate per hour (daily weighted average) μ_i	Service rate per hour/L μ_i / L
1	0	0.57	0.00	0.00
2	3	1.75	1.72	0.859
3	8	3.38	2.37	0.789
4	9	5.86	1.54	0.384
5	18	8.59	2.10	0.419
6	28	14.42	1.94	0.324
7	40	23.98	1.67	0.238
8	86	26.56	3.24	0.405
9	103	37.72	2.73	0.303
10	159	52.48	3.03	0.303
11	263	78.74	3.34	0.304
12	365	100.20	3.64	0.304
13	457	123.71	3.69	0.284
14	598	143.90	4.16	0.297
15	730	173.82	4.20	0.280
16	908	210.16	4.32	0.270
17	1107	242.98	4.56	0.268
18	1319	288.71	4.57	0.254
19	1631	331.77	4.92	0.259
20	1954	384.29	5.08	0.254
21	2253	413.00	5.46	0.260
22	2457	433.29	5.67	0.258
23	2663	450.64	5.91	0.257
24	2784	464.71	5.99	0.250
25	2882	487.89	5.91	0.236
26	3233	508.23	6.36	0.245
27	3397	504.92	6.73	0.249
28	3574	538.88	6.63	0.237
29	3845	559.07	6.88	0.237
30	3803	541.64	7.02	0.234
31	4006	564.58	7.10	0.229
32	4131	562.56	7.34	0.229
33	4188	547.74	7.65	0.232
34	4034	523.63	7.70	0.227
35	3879	498.02	7.79	0.223
36	3747	466.11	8.04	0.223
37	3589	441.67	8.13	0.220
38	3538	415.42	8.52	0.224
39	3177	378.85	8.39	0.215
40	2881	333.49	8.64	0.216
41	2556	290.57	8.80	0.215
42	2310	260.01	8.88	0.212
43	2124	237.36	8.95	0.208
44	1896	210.47	9.01	0.205
45	1705	186.48	9.14	0.203
46	1529	157.28	9.72	0.211
47	1241	135.51	9.16	0.195
48	1159	116.82	9.92	0.207
49	1007	101.85	9.89	0.202
50	867	84.77	10.23	0.205
51	721	72.75	9.91	0.194
52	629	62.24	10.11	0.194
53	500	47.64	10.50	0.198
54	397	37.57	10.57	0.196

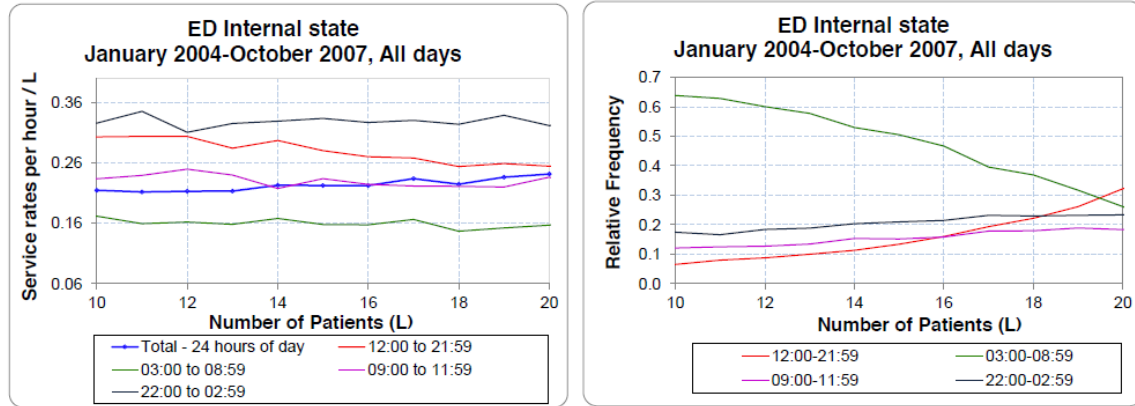
55	326	28.10	11.60	0.211
56	240	22.54	10.65	0.190
57	182	18.22	9.99	0.175
58	134	12.12	11.06	0.191
59	107	8.83	12.11	0.205
60	78	5.93	13.15	0.219
61	57	4.63	12.32	0.202
62	39	4.41	8.84	0.143
63	34	2.64	12.90	0.205
64	27	1.59	17.03	0.266
65	8	0.41	19.63	0.302
66	4	0.59	6.83	0.104
67	4	0.56	7.17	0.107
68	2	0.09	22.57	0.332
69	1	0.07	15.00	0.217
70	1	0.07	13.38	0.191

Internal ED, January 2004 - October 2007, all days, over 5 hours of day, from 22:00:00 to 02:59:59				
ED state (number of patients) L	Departures, total over all period $\sum_i D_i$	ED state duration in hours, total over all period $\sum_i T_i$	Service rate per hour (daily weighted average) μ_i	Service rate per hour/L μ_i / L
0	0	0.48	0.00	
1	2	5.05	0.40	0.396
2	8	3.93	2.04	1.018
3	15	13.17	1.14	0.380
4	27	17.35	1.56	0.389
5	48	30.42	1.58	0.316
6	104	55.72	1.87	0.311
7	182	71.10	2.56	0.366
8	238	81.42	2.92	0.365
9	318	109.79	2.90	0.322
10	455	139.76	3.26	0.326
11	621	163.56	3.80	0.345
12	782	209.84	3.73	0.311
13	986	233.39	4.22	0.325
14	1190	258.46	4.60	0.329
15	1361	272.11	5.00	0.333
16	1472	281.54	5.23	0.327
17	1637	291.72	5.61	0.330
18	1740	298.51	5.83	0.324
19	1893	294.11	6.44	0.339
20	1791	278.52	6.43	0.322
21	1923	280.72	6.85	0.326
22	1920	275.95	6.96	0.316
23	2070	271.90	7.61	0.331
24	1993	261.72	7.62	0.317
25	1984	249.12	7.96	0.319
26	1933	232.28	8.32	0.320
27	1940	217.98	8.90	0.330
28	1864	204.77	9.10	0.325
29	1775	193.04	9.19	0.317
30	1723	176.72	9.75	0.325
31	1608	160.93	9.99	0.322
32	1472	150.27	9.80	0.306
33	1433	143.17	10.01	0.303
34	1302	127.53	10.21	0.300
35	1317	111.32	11.83	0.338
36	1109	102.56	10.81	0.300
37	1005	89.61	11.22	0.303
38	902	88.87	10.15	0.267
39	871	75.53	11.53	0.296
40	721	66.75	10.80	0.270
41	683	58.36	11.70	0.285
42	671	52.43	12.80	0.305
43	611	44.99	13.58	0.316

44	515	40.71	12.65	0.287
45	447	34.93	12.80	0.284
46	334	27.28	12.24	0.266
47	305	23.99	12.72	0.271
48	299	22.92	13.05	0.272
49	227	21.50	10.56	0.216
50	203	17.31	11.73	0.235
51	135	14.08	9.59	0.188
52	137	10.02	13.67	0.263
53	129	7.96	16.21	0.306
54	121	7.57	15.99	0.296
55	80	7.84	10.20	0.185
56	62	6.04	10.26	0.183
57	76	5.44	13.98	0.245
58	37	2.63	14.08	0.243
59	18	1.39	12.98	0.220
60	23	0.72	31.83	0.531
61	14	0.33	42.71	0.700
62	2	0.07	27.07	0.437
63	1	0.27	3.76	0.060
64	2	0.19	10.40	0.163
65	2	0.16	12.24	0.188
66	3	0.20	14.84	0.225

Fig 8: Service rate as a function of $10 \leq L \leq 20$ (left), and Relative frequency (weight) of occupancy regime per L (right)

SEE DETAILS IN [APPENDIX 2 \(PART 2.2\)](#).



Internal ED, January 2004 - October 2007, all days																			
number of patients	over 6 hours of day, from 03:00:00 to 08:59:59				over 3 hours of day, from 09:00:00 to 11:59:59				over 10 hours of day, from 12:00:00 to 21:59:59				over 5 hours of day, from 22:00:00 to 02:59:59				over 24 hours of day		
	departures	state duration (hours)	service rate per hour/L	state duration (hours) percent to 24 hours	departures	state duration (hours)	service rate per hour/L	state duration (hours) percent to 24 hours	departures	state duration (hours)	service rate per hour/L	state duration (hours) percent to 24 hours	departures	state duration (hours)	service rate per hour/L	state duration (hours) percent to 24 hours	departures	state duration (hours)	service rate per hour/L
10	877	511.2	0.172	0.639	226	96.8	0.233	0.121	159	52.5	0.303	0.066	455	139.8	0.326	0.175	1717	800.3	0.215
20	978	311.8	0.157	0.261	1033	218.6	0.236	0.183	1954	384.3	0.254	0.322	1791	278.5	0.322	0.233	5756	1193.1	0.241

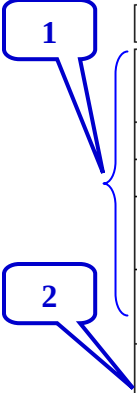
Internal ED, January 2004 - October 2007, all days					
number of patients	service rate per hour/L over 6 hours of day, from 03:00:00 to 08:59:59	service rate per hour/L over 3 hours of day, from 09:00:00 to 11:59:59	service rate per hour/L over 10 hours of day, from 12:00:00 to 21:59:59	service rate per hour/L over 5 hours of day, from 22:00:00 to 02:59:59	service rate per hour/L over 24 hours of day
10	0.172	0.233	0.303	0.326	0.215
20	0.157	0.236	0.254	0.322	0.241

Internal ED, January 2004 - October 2007, all days				
number of patients	state duration (hours) percent to 24 hours over 6 hours of day, from 03:00:00 to 08:59:59	state duration (hours) percent to 24 hours over 3 hours of day, from 09:00:00 to 11:59:59	state duration (hours) percent to 24 hours over 10 hours of day, from 12:00:00 to 21:59:59	state duration (hours) percent to 24 hours over 5 hours of day, from 22:00:00 to 02:59:59
10	0.639	0.121	0.066	0.175
20	0.261	0.183	0.322	0.233

4. Internal Wards

4.1. Basic facts

Table 1: Internal wards: operational profile



	Ward A	Ward B	Ward C	Ward D	Ward E
Average LOS (days) (STD)	6.0 (7.9)	3.9 (5.4)	4.9 (10.1)	5.1 (6.6)	3.7 (3.3)
Mean occupancy level	97.7%	94.4%	86.7%	96.9%	103.2%
Mean # patients per month	206.3	193.5	209.7	216.5	178.7
Standard (maximal) capacity (# beds)	45 (52)	30 (35)	44 (46)	42 (44)	24
Mean # patients per bed per month	4.58	6.45	4.77	5.16	7.44
Readmission rate (within 1 month)	10.6%	11.2%	11.8%	9.0%	6.4%

Reproducing steps (1):

Average LOS (days):

Click *Main* → *Statistical Models (Summaries)*. Select *Distributions*, then *Estimates*. From the variables list, select *Patient length of stay in Ward (days)(by physical location)*. In the *Select Categories* tab, select *Internal Medicine A*, *Internal Medicine B*, *Internal Medicine C*, *Internal Medicine D*, and *Internal Medicine E*. Click the *Dates* → button. Select *Dates totals only* and 15 months from *May 2006 to December 2006* and from *April 2007 to October 2007*. Open tab *Days* and select *All days*. Click *OK*.

Original SEESTat table:

HomeHospital Patient length of stay in Ward (days)(by physical location), Total for May2006 June2006 July2006 August2006 September2006 October2006 November2006 December2006 April2007 May2007 June2007 July2007 August2007 September2007 October2007, All days					
Statistics					
	Internal Medicine A	Internal Medicine B	Internal Medicine C	Internal Medicine D	Internal Medicine E
N	3094	2902	3146	3248	2680
N(average per day)	6.74	6.32	6.85	7.08	5.84
Mean	6.023	3.895	4.93	5.079	3.726
Standard Deviation	7.891	5.36	10.11	6.574	3.286
Variance	62.27	28.73	102.11	43.21	10.8
Median	4	3	3	3	3
Minimum	0	0	0	0	0
Maximum	133	96	370	87	51

Mean occupancy level = number of patients / number of beds. For example: $97.7\% = 43.978/45 \times 100\%$
number of patients calculated by averages by all days, over 24 hours of day

Mean # patients per month = $N/15$. For example: $206.3 = 3094/15$

Mean # patients per bed per month = mean number of patients per month/ number of beds. For example: $4.58 = 206.3/45$

Reproducing number of patients:

Click *Main* → *Statistical Models (Summaries)*. Select *Time Series*, then *Intraday*. From the variables list, select *Number of Patients in Ward (by physical location)*. In the *Select Categories* tab, in the category *hospital_unit* select *Total*, in the subcategory *physical_hospital_unit* select *Internal Medicine A*, *Internal Medicine B*, *Internal Medicine C*, *Internal Medicine D*, and *Internal Medicine E*. Open the *X Properties* tab. Select resolution $60:00 = 1$ hour. Click the *Dates* → button. Select *Dates totals only* and 15 months from *May 2006 to December 2006* and from *April 2007 to October 2007*. Open tab *Days* and select *All days*. Click *OK*.

Original SEESat table:

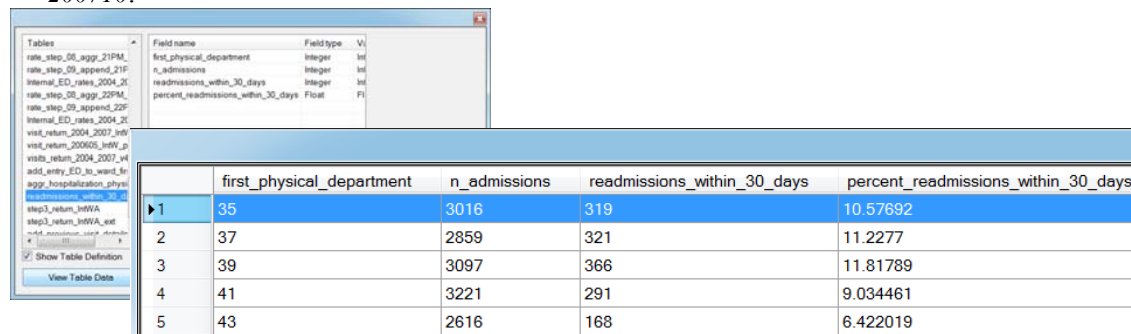
HomeHospital Number of Patients in Ward (by physical location), Total for May2006 June2006 July2006 August2006 September2006 October2006 November2006 December2006 April2007 May2007 June2007 July2007 August2007 September2007 October2007, All days					
Time	Internal Medicine A	Internal Medicine B	Internal Medicine C	Internal Medicine D	Internal Medicine E
00:00	43.854	28.261	37.989	40.529	24.817
01:00	44.081	28.464	38.181	40.756	24.906
02:00	44.281	28.688	38.416	41.085	25.017
03:00	44.473	28.843	38.595	41.392	25.085
04:00	44.586	28.911	38.695	41.547	25.129
05:00	44.669	28.985	38.776	41.595	25.153
06:00	44.747	29.065	38.813	41.614	25.161
07:00	44.769	29.122	38.834	41.634	25.181
08:00	44.821	29.166	38.889	41.697	25.285
09:00	44.908	29.246	38.961	41.723	25.484
10:00	44.976	29.338	39.085	41.850	25.632
11:00	45.089	29.418	39.229	41.969	25.821
12:00	45.094	29.373	39.338	41.989	25.930
13:00	45.076	29.259	39.312	41.943	25.821
14:00	45.041	28.932	39.259	41.959	25.577
15:00	44.571	28.307	38.647	40.952	24.501
16:00	42.869	27.120	37.233	38.680	23.538
17:00	42.251	26.702	36.800	38.473	23.370
18:00	42.122	26.643	36.514	38.460	23.255
19:00	42.185	26.717	36.532	38.645	23.481
20:00	42.388	26.863	36.595	38.965	23.715
21:00	42.641	27.052	36.730	39.312	23.908
22:00	42.928	27.353	37.028	39.693	24.118
23:00	43.157	27.586	37.277	39.950	24.246
00:00	43.865	28.253	37.972	40.516	24.810
average	43.978	28.307	38.148	40.677	24.758

Reproducing steps (2): Readmission rate:

Click *View* → *DBTables (Data)*.

From the table list, select *readmissions_within_30_days_200605_IntW_physical*.

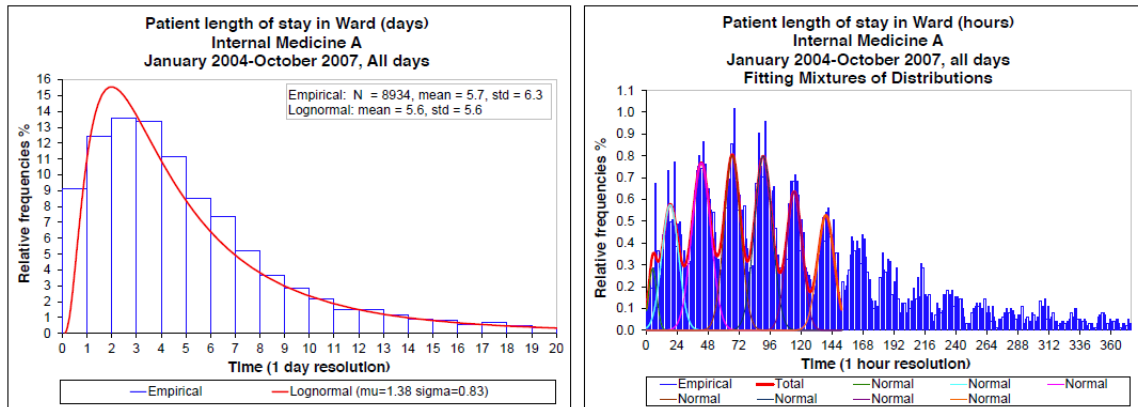
Click the *View Table Data* button. The readmission rate calculation based on *physical_details* database table and *visit_return_200605_IntW_physical* aggregated table, where *entry_year_month* ≥ 200605 and *entry_year_month* ≤ 200612 or *entry_year_month* ≥ 200704 and *entry_year_month* ≤ 200710 .



	first_physical_department	n_admissions	readmissions_within_30_days	percent_readmissions_within_30_days
1	35	3016	319	10.57692
2	37	2859	321	11.2277
3	39	3097	366	11.81789
4	41	3221	291	9.034461
5	43	2616	168	6.422019

4.2. EDA: LOS - a story of multiple time scales

Fig 9: LOS distribution of IW A in two time-scales: daily and hourly

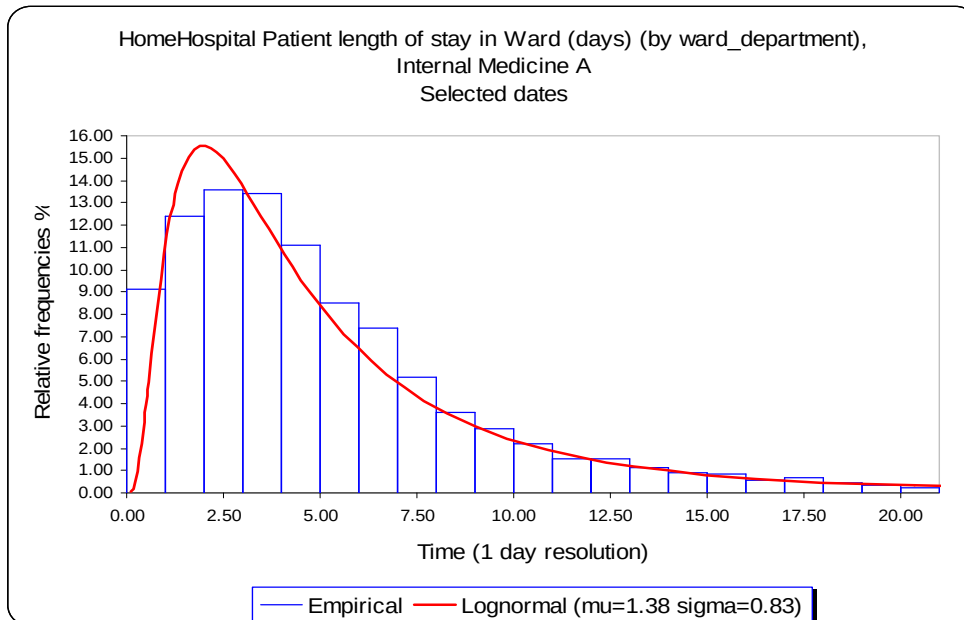


Reproducing steps:

1. Creating chart:

Click *Main* → *Statistical Models (Summaries)*. Select *Distribution*, then *Fitting*. From the variables list, select *Patient length of stay in Ward (days) (by ward_department)*. In the *Options* tab, select *Lognormal* distribution. In the *Select Categories* tab, select *Internal Medicine A*. Open the *X Properties* tab. Select resolution *1 day*; range to display: low limit – minimal value, upper limit–97.5%, and range to compute: low limit 1, upper limit 100%. Click the *Dates* → button. Select *Dates totals only* and all months from *January 2004* to *October 2007*. Open tab *Days* and select *All days*. Click *OK*.

Original SEESat chart:



Original SEEStat table:

Statistics		Parameters for Lognormal Distribution	
	Patient length of stay in Ward (days) (by ward_department)	Parameter	Estimate
N	8934	mu	1.38
N(average per day)	6.381428571	sigma	0.83
Mean	5.665	mean	5.593
Standard Deviation	6.284	std	5.579
Variance	39.49		
Median	4		
Minimum	1		
Maximum	151		
Skewness	6.026		
Kurtosis	76.67		
Standard Error Mean	0.0665		
Interquartile Range	5		
Mean Absolute Deviation	3.688		
Median Absolute Deviation(MAD)	2		
Coefficient of Variation(CV) (%)	110.92		
L-moment 2 (half of Gini's Mean Difference)	2.552		
L-Skewness	0.411		
L-Kurtosis	0.271		
Coefficient of L-variation(L-CV)(%) (Gini's Coefficient)	45.05		

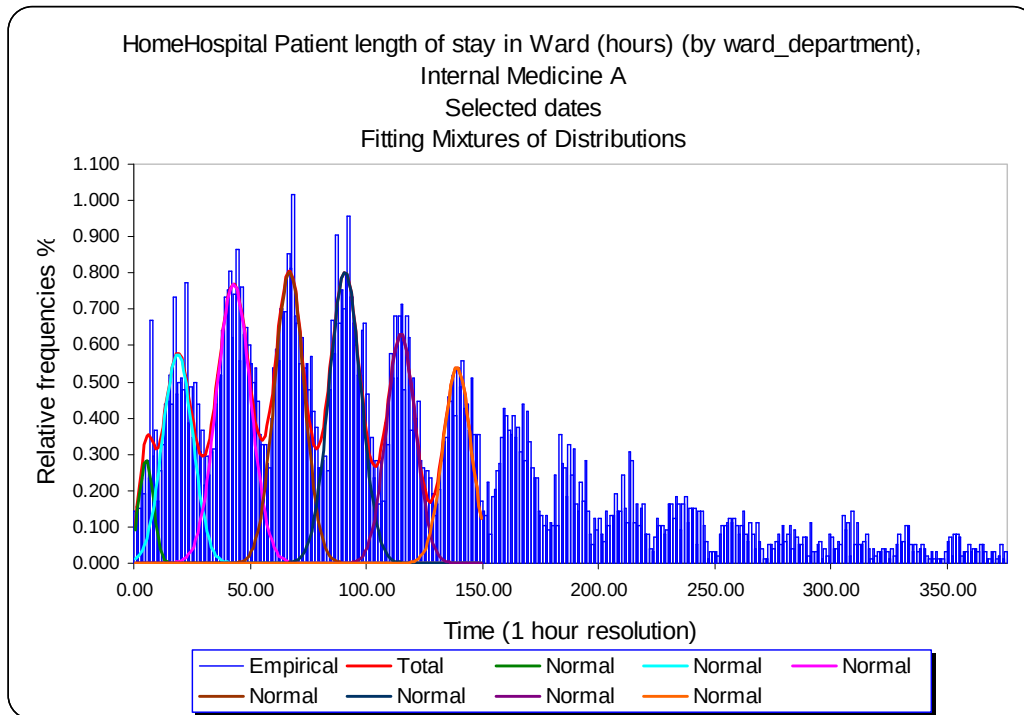
2. Design the original SEEStat chart:

Change in the chart title *Selected dates* to January 2004–October 2007, All days.

3. Click <–New Model button. Select *Distribution*, then *Mixture fitting*. From the variables list, select *Patient length of stay in Ward (hours) (by ward_department)*. In the *Options* tab, select *Normal* distribution. Set the number of mixture components to 7. In the *Select Categories* tab, select *Internal Medicine A*. Open the *X Properties* tab, select resolution 1 hour, click on *Range to Compute* button, then *Select Range*, mark *Values* and set upper limit 150 = 150 hours, range to display: low limit – minimal value, upper limit – 95%.

Click the *Dates* → button. Select *Dates totals only* and all months from *January 2004* to *October 2007*. Open tab *Days* and select *All days*. Click *OK*.

Original SEEStat chart:

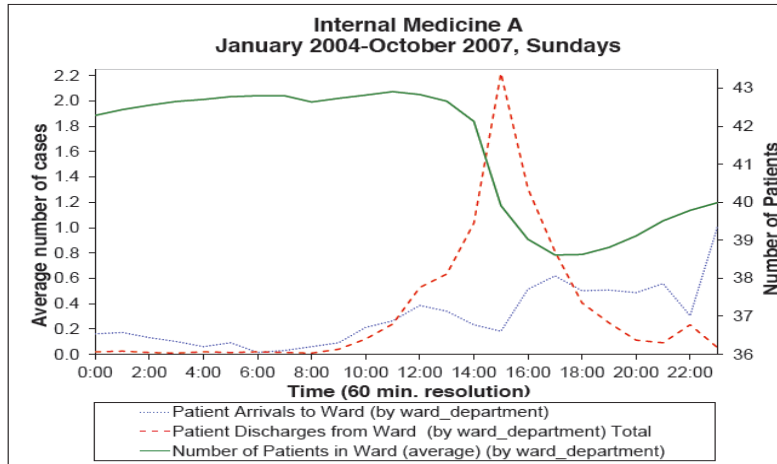


4. Design the original SEEStat chart:

Change in the chart title *Selected dates* to *January 2004 – October 2007, All days*.

Format horizontal axis: set major unit 24, decimal places 0.

Fig 10: Arrivals, departures, and average number of patients in Internal wards by hour of day



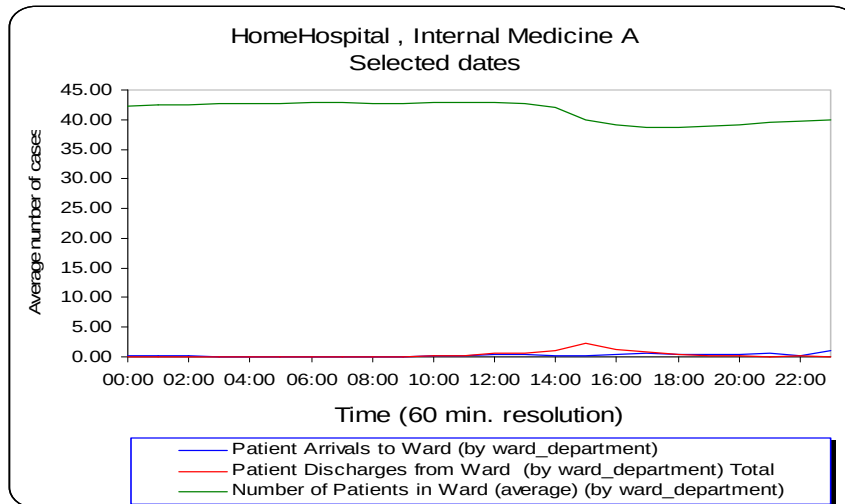
Reproducing steps:

1. Creating chart:

Click *Main* → *Statistical Models (Summaries)*. Select *Time Series*, then *Intraday*.

From the variables list, select *Patient Arrivals to Ward (by_ward_department)*, *Patient Discharges from Ward (by_ward_department)* and *Number of Patients in Ward (average) (by_ward_department)*. In the *Select Categories* tab, select *Internal Medicine A*. Open the *X Properties* tab. Select resolution 60:00 = 1 hour. Click the *Dates* → button. Select *Dates totals only* and all months from *January 2004* to *October 2007*. Open tab *Days* and select *Sundays*. Click *OK*.

Original SEEStat chart:

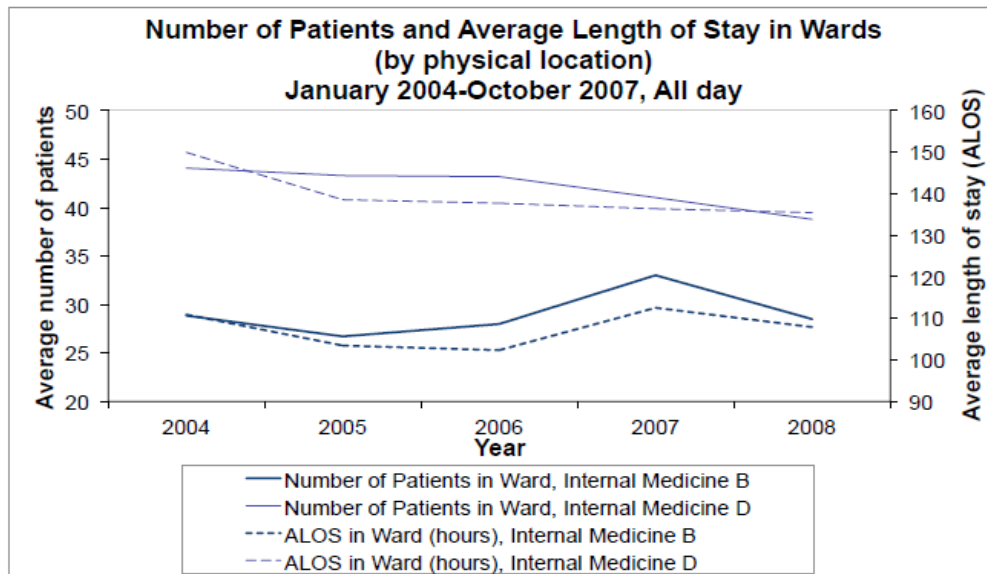


2. Design the original SEEStat chart:

Add and format secondary vertical axis for *Number of Patients in Ward (average) (by_ward_department)*, format primary vertical axis. (see in [Appendix 5](#) How to add a secondary vertical axis in Excel). Change in the chart title *Selected dates* to *January 2004 – October 2007, Sundays*.

4.3.3. Diseconomies of scale (or how ward size affects LOS)

Fig 11: Average LOS and number of patients in Internal wards B and D by year



Remark: Figure 11 presents data of years 2004-2008, reproducing by SEESat was available only till 2007 using the following procedure.

Reproducing steps:

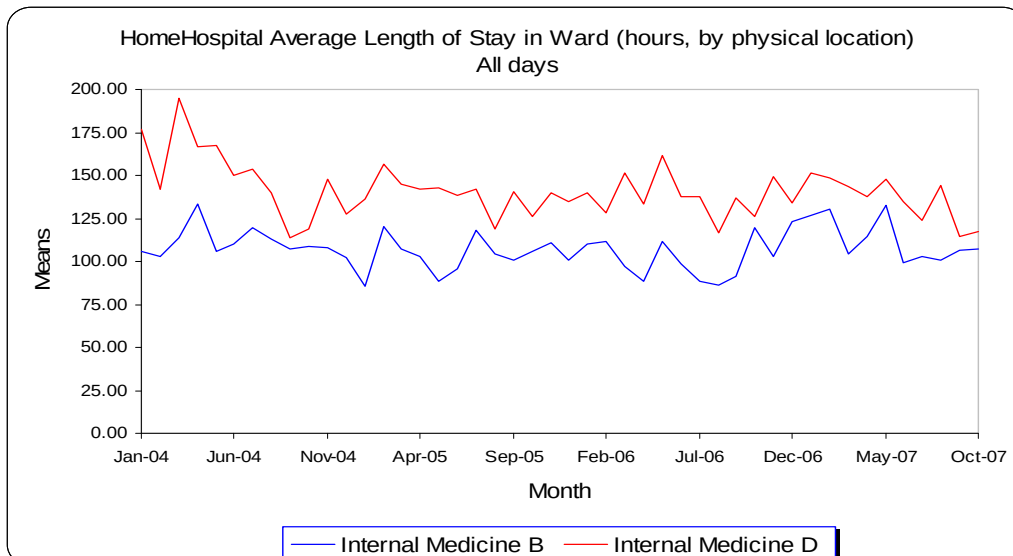
1. Creating chart:

Click *Main* → *Statistical Models (Summaries)*. Select *Time Series*, then *Daily Totals*.

From the variables list, select *Average Length of Stay in Ward (hours, by physical location)*. In the *Select Categories* tab, select *Internal Medicine B* and *Internal Medicine D*.

Click the *Dates* → button. Click on *Select all* button. Open tab *Days* and select *All days*. Click *OK*.

Original SEESat chart and table:



<i>Time Series</i>		
<i>HomeHospital Average Length of Stay in Ward (hours, by physical location)</i>		
<i>All days</i>		
<i>Means</i>		
<i>Date</i>	<i>Internal Medicine B</i>	<i>Internal Medicine D</i>
Jan-04	106.09	177.05
Feb-04	103.06	141.81
Mar-04	113.41	194.95
Apr-04	133.40	166.72
May-04	105.98	167.11
Jun-04	110.13	149.88
Jul-04	119.74	153.79
Aug-04	113.39	139.61
Sep-04	106.96	114.04
Oct-04	108.83	118.73
Nov-04	108.12	148.13
Dec-04	101.97	127.77
Jan-05	85.61	136.28
Feb-05	120.28	156.48
Mar-05	107.52	145.23
Apr-05	102.87	141.76
May-05	88.39	142.89
Jun-05	95.93	138.12
Jul-05	118.14	141.80
Aug-05	104.28	119.08
Sep-05	101.07	140.31
Oct-05	105.89	126.00
Nov-05	111.01	139.81
Dec-05	100.42	134.96
Jan-06	109.79	139.99
Feb-06	111.90	127.98
Mar-06	97.05	151.47
Apr-06	88.35	133.29
May-06	111.28	161.75
Jun-06	98.43	137.51
Jul-06	88.71	137.76
Aug-06	86.17	117.01
Sep-06	91.46	136.67
Oct-06	119.36	125.94
Nov-06	102.61	149.11
Dec-06	122.83	134.36
Jan-07	126.95	151.27
Feb-07	130.53	148.54
Mar-07	104.61	143.65
Apr-07	114.50	137.85
May-07	132.50	147.47
Jun-07	99.13	134.64
Jul-07	103.07	124.04
Aug-07	100.45	144.54
Sep-07	106.69	114.79
Oct-07	107.16	117.21

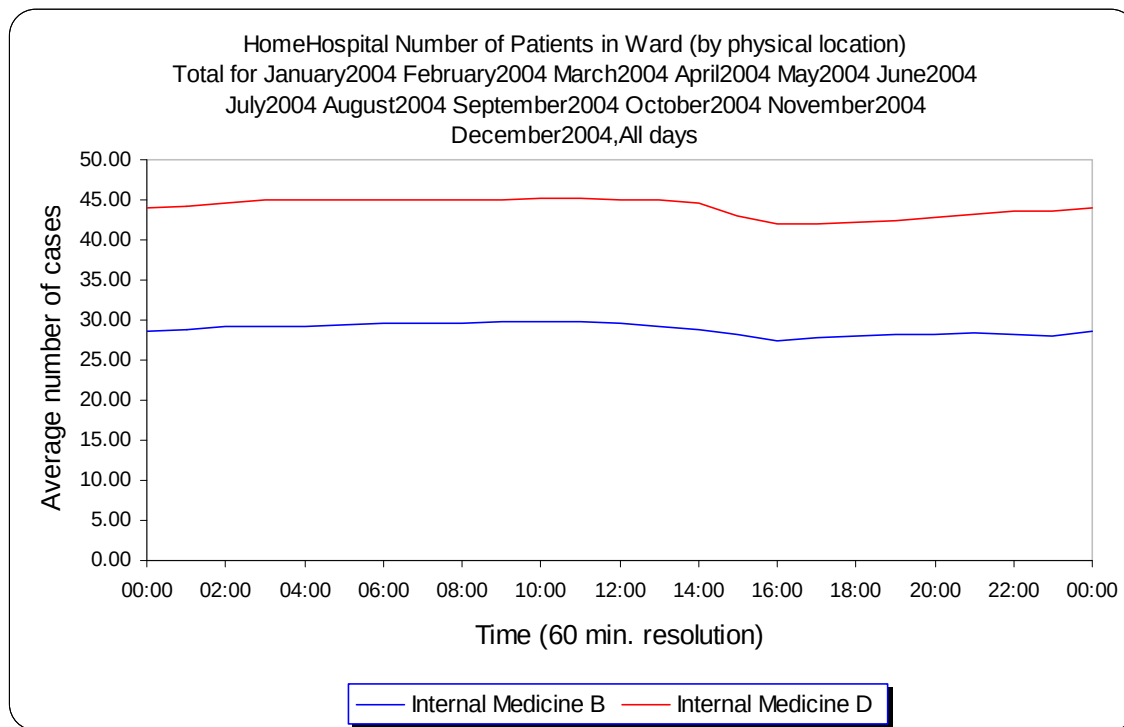
2. Creating chart:

Click *New Model*. Select *Time Series*, then *Intraday*.

From the variables list, select *Number of Patients in Ward (by physical location)*. In the *Select Categories* tab, in subcategory *physical_hospital_unit* select *Internal Medicine B* and *Internal Medicine D*. Open the *X Properties* tab. Select resolution *60:00 = 1 hour*. Click the *Dates ->* button. Select *Dates totals only* and select all months of 2004 year. Open tab *Days* and select *All days*. Click *OK*.

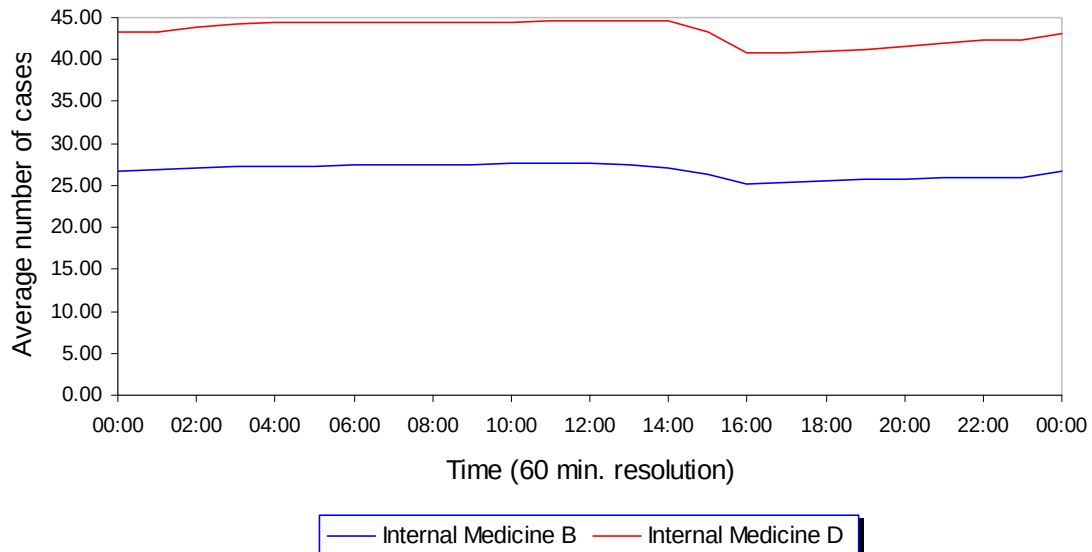
3. Repeat step 2 for 2005, 2006 and 2007 years.

Original SEESat chart and table:

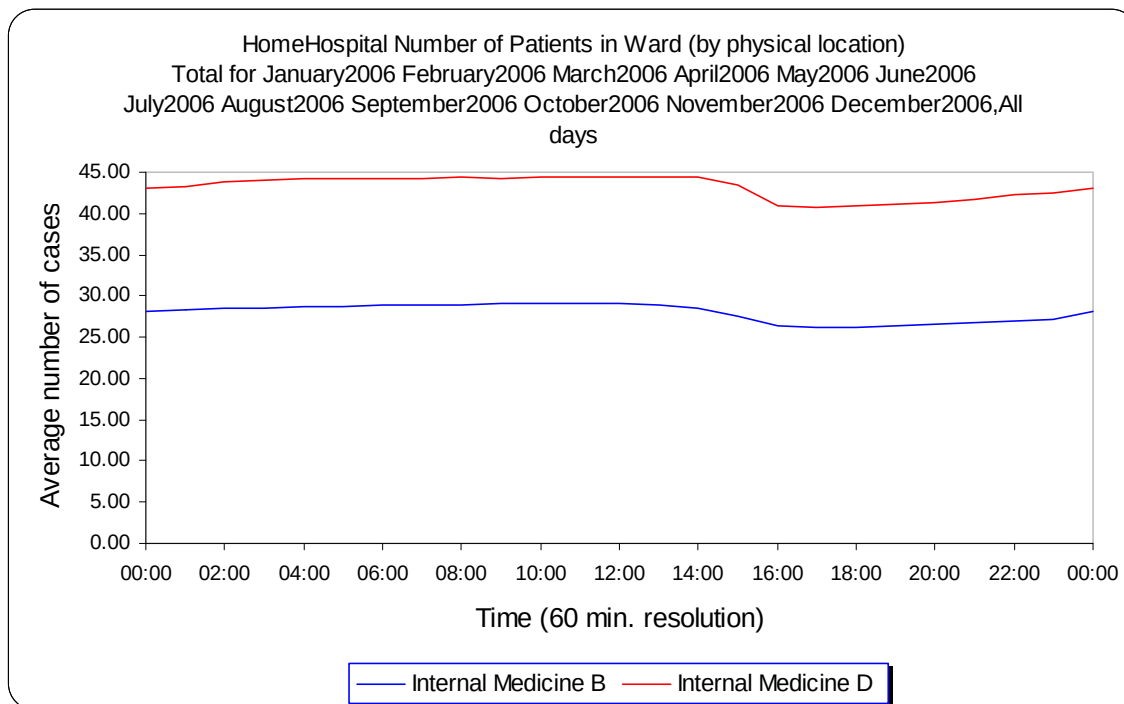


<i>Data</i>		
<i>Time</i>	<i>Internal Medicine B</i>	<i>Internal Medicine D</i>
00:00	28.615	43.984
01:00	28.858	44.246
02:00	29.131	44.639
03:00	29.243	44.962
04:00	29.273	45.049
05:00	29.344	45.063
06:00	29.566	45.055
07:00	29.675	45.052
08:00	29.697	45.068
09:00	29.760	45.052
10:00	29.822	45.104
11:00	29.724	45.148
12:00	29.530	45.093
13:00	29.260	44.934
14:00	28.869	44.628
15:00	28.287	43.087
16:00	27.473	41.954
17:00	27.754	42.063
18:00	27.929	42.197
19:00	28.197	42.484
20:00	28.172	42.792
21:00	28.301	43.172
22:00	28.265	43.508
23:00	27.997	43.519
00:00	28.694	44.098

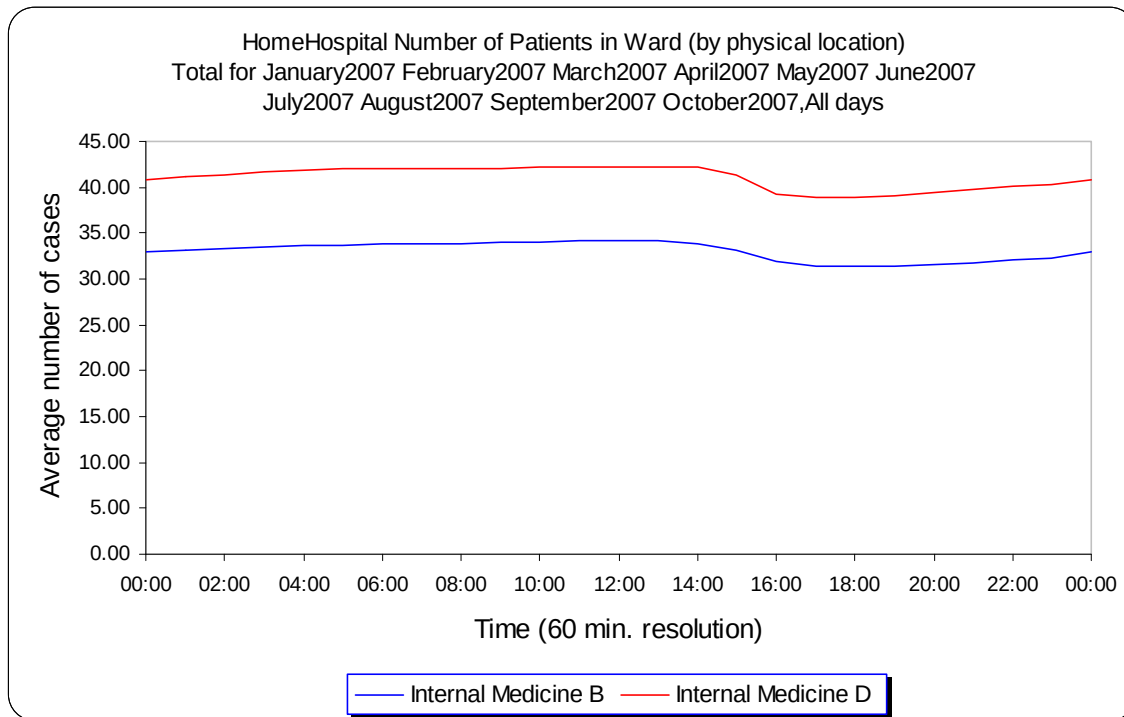
HomeHospital Number of Patients in Ward (by physical location)
Total for January2005 February2005 March2005 April2005 May2005 June2005
July2005 August2005 September2005 October2005 November2005
December2005,All days



Data		
Time	Internal Medicine B	Internal Medicine D
00:00	26.690	43.192
01:00	26.912	43.378
02:00	27.101	43.915
03:00	27.173	44.285
04:00	27.175	44.414
05:00	27.203	44.436
06:00	27.403	44.400
07:00	27.477	44.375
08:00	27.471	44.359
09:00	27.501	44.384
10:00	27.564	44.468
11:00	27.570	44.584
12:00	27.573	44.655
13:00	27.414	44.707
14:00	27.099	44.619
15:00	26.326	43.258
16:00	25.241	40.882
17:00	25.307	40.814
18:00	25.515	40.967
19:00	25.699	41.258
20:00	25.759	41.545
21:00	25.912	41.907
22:00	26.019	42.345
23:00	25.855	42.386
00:00	26.685	43.186



Data		
Time	Internal Medicine B	Internal Medicine D
00:00	28.049	43.058
01:00	28.258	43.332
02:00	28.471	43.740
03:00	28.600	44.082
04:00	28.630	44.260
05:00	28.696	44.279
06:00	28.847	44.282
07:00	28.940	44.293
08:00	28.959	44.326
09:00	29.030	44.321
10:00	29.129	44.400
11:00	29.162	44.474
12:00	29.003	44.447
13:00	28.921	44.405
14:00	28.466	44.449
15:00	27.567	43.364
16:00	26.436	40.855
17:00	26.222	40.732
18:00	26.268	40.847
19:00	26.389	41.134
20:00	26.573	41.400
21:00	26.751	41.759
22:00	27.025	42.192
23:00	27.249	42.389
00:00	28.063	43.085

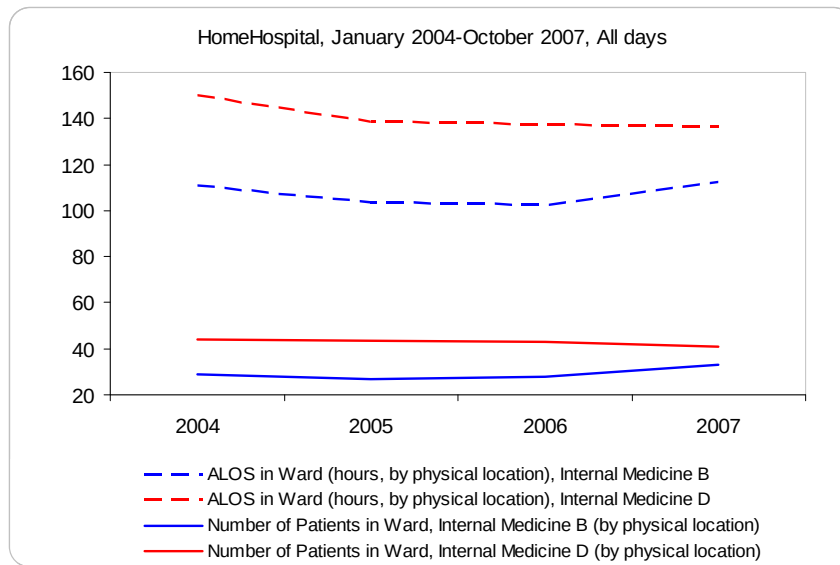


Data		
Time	Internal Medicine B	Internal Medicine D
00:00	32.895	40.878
01:00	33.105	41.076
02:00	33.352	41.405
03:00	33.516	41.740
04:00	33.622	41.888
05:00	33.688	41.957
06:00	33.760	41.974
07:00	33.796	42.000
08:00	33.832	42.056
09:00	33.928	42.049
10:00	34.033	42.164
11:00	34.164	42.266
12:00	34.214	42.280
13:00	34.115	42.257
14:00	33.888	42.174
15:00	33.188	41.296
16:00	31.957	39.220
17:00	31.414	38.918
18:00	31.359	38.852
19:00	31.398	38.997
20:00	31.493	39.342
21:00	31.681	39.720
22:00	32.010	40.125
23:00	32.243	40.319
00:00	32.878	40.829

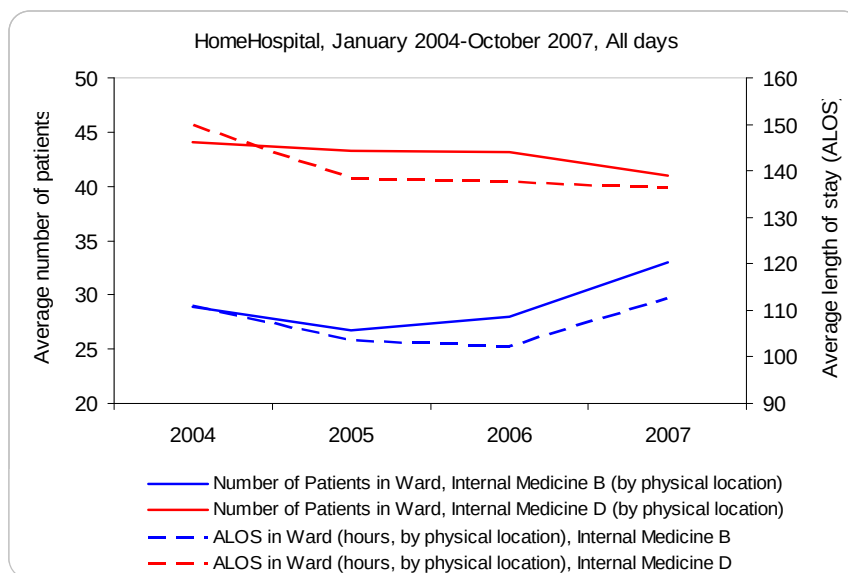
4. Compute averages by department and by year.

	ALOS in Ward (hours, by physical location), Internal Medicine B	ALOS in Ward (hours, by physical location), Internal Medicine D	Number of Patients in Ward, Internal Medicine B (by physical location)	Number of Patients in Ward, Internal Medicine D (by physical location)
2004	110.92	149.97	28.86	44.08
2005	103.45	138.56	26.71	43.31
2006	102.33	137.74	27.99	43.20
2007	112.56	136.40	33.02	41.03

5. Create a line chart.



6. Add secondary vertical axis for ALOS and add axis titles.

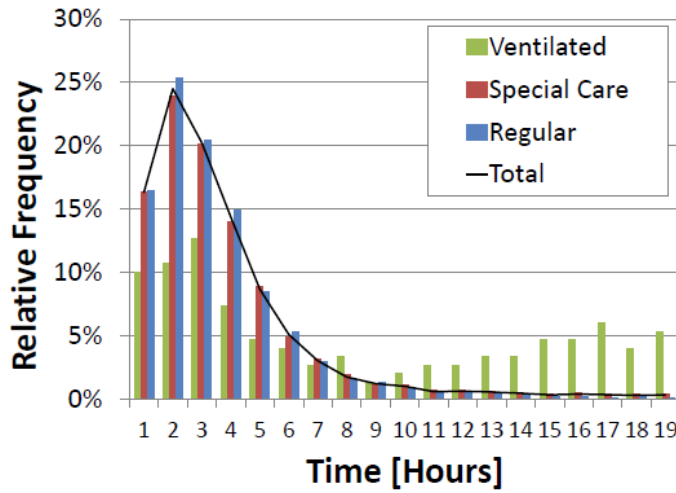


5. The ED+IW Network

5.2. Delays in transfer

Fig 12: Transfer time by patient type, in hours

Remark: Figure 12 was based on the “justice table” from 2006 to 2008. However, due to technical problems this data could not be integrated into the rest of the database completely. Using SEESat one can create the total distribution of transfer time, as will be demonstrated here based on data of years X-Y; the partition to patient type: Ventilated, Special Care and Regular is not available through SEESat.

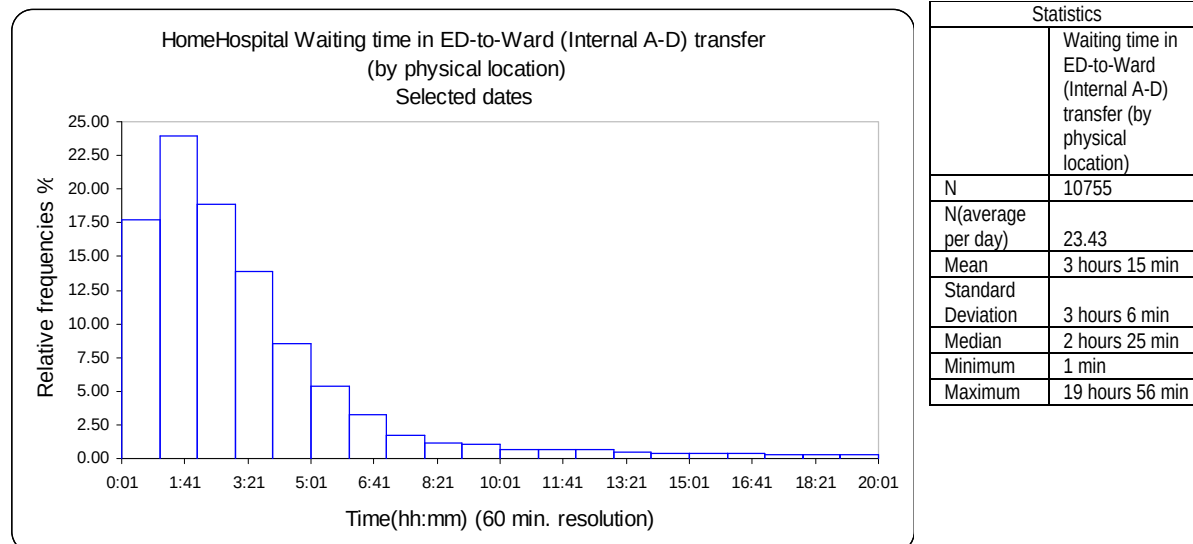


Creating chart:

Click *Main* → *Statistical Models (Summaries)*. Select *Distribution*, then *Estimates*.

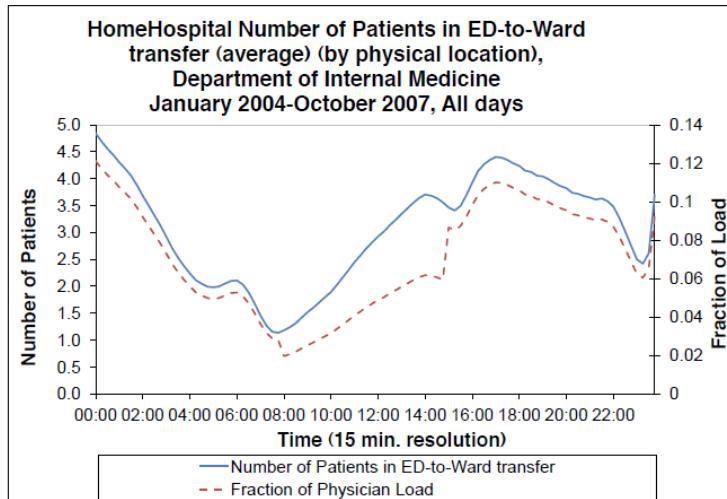
From the variables list, select *Waiting time in ED-to-Ward (Internal A-D) transfer (by physical location)*. Open the *X Properties* tab. Select resolution 60:00 minutes; range to display: low limit – minimal value, upper limit – 100%. Click the *Dates* → button. Select *Dates totals only* and months from *May 2006 to December 2006* and from *April 2007 to October 2007*. Open tab *Days* and select *All days*. Click *OK*.

Original SEESat chart



5.3. Influence of transfer delays on the ED

Fig 13: Number of patients in ED-to-IW transfer (A-E) and the fraction of time that ED physicians devote to these patients

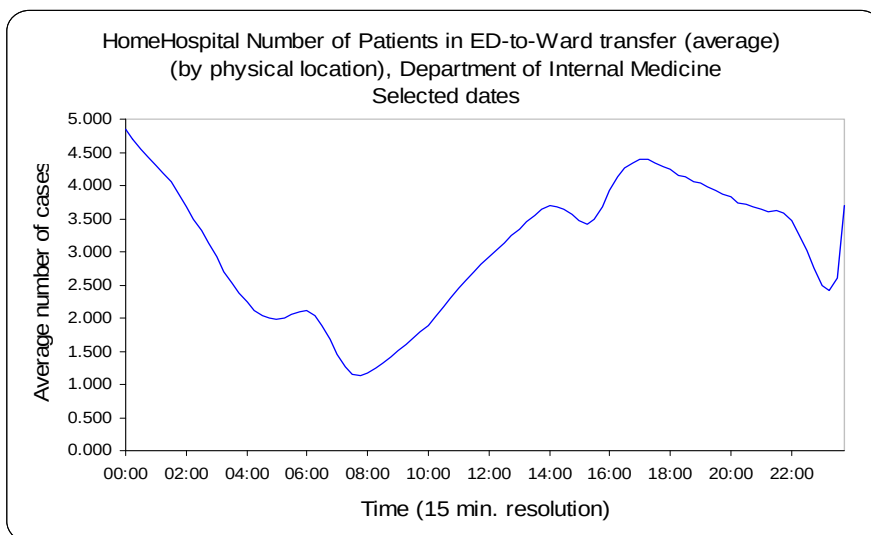


Reproducing steps:

1. Creating chart:

Click *Main* → *Statistical Models (Summaries)*. Select *Time Series*, then *Intraday*. From the variables list, select *Number of Patients in ED-to-Ward transfer (average) (by physical location)*. In the *Select Categories* tab, select sub-category *Department of Internal Medicine*. Open the *X Properties* tab. Select resolution *15:00 = 15 min.* Click the *Dates* → button. Select *Dates totals only* and all months from *January 2004* to *October 2007*. Open tab *Days* and select *All days*. Click *OK*.

Original SEESat chart:



2. Design the original SEEStat chart:

Change in the chart title *Selected dates* to *January 2004 – October 2007, All days*.

3. Calculate fraction of physician load:

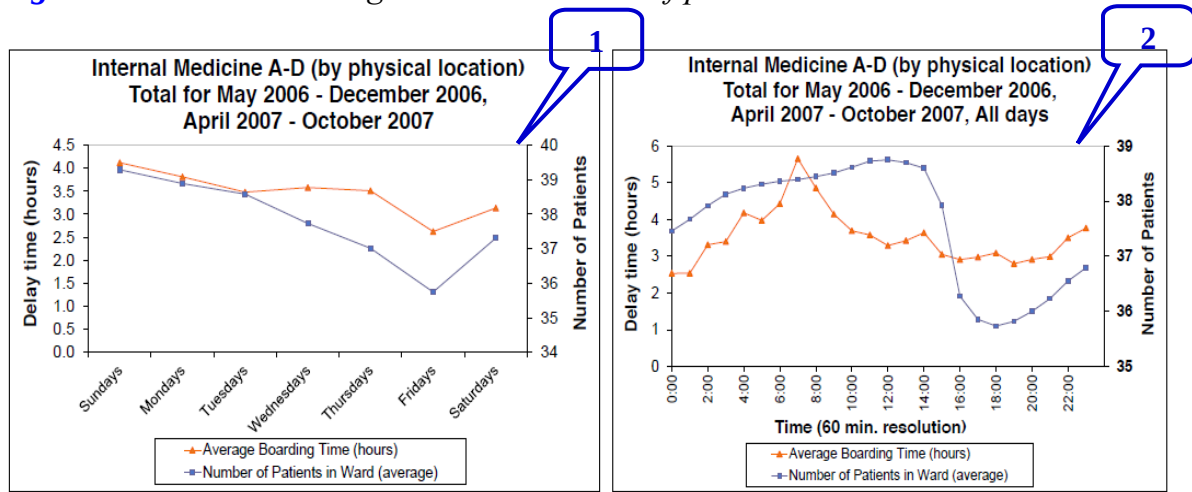
Estimates of the fraction of time that ED physicians spent caring for the transfer patients, assuming (the Rambam experience) that every such patient requires 1.5 minutes of physician's time every 15 minutes:

*Fraction of physician load in 15 minute interval i = (number of patients in ED-to-IW transfer * 1.5 minutes) / (number of physicians in interval i * 15 minutes)*

time	number of physicians in Internal ED
08:00-15:00	6
15:00-23:00	4
23:00-08:00	4

5.6 A system view

Fig 16: ED-to-IW boarding times and number of patients in IW



Reproducing steps (1):

1. Creating data table: click *Main* → *Statistical Models (Summaries)*. Select *Time Series*, then *Intraday*. From the variables list, select *Average Delay in ED-to-Ward transfer (hours)(by physical location)*. In the *Categories* tab, select *Internal Medicine A*, *Internal Medicine B*, *Internal Medicine C*, *Internal Medicine D*. Open the *X Properties* tab. Select resolution 60:00 minutes. Click the *Dates* → button. Select *Dates totals only* and months from *May 2006* to *December 2006* and from *April 2007* to *October 2007*. Open tab *Days* and select *Sundays*. Click *OK*.
2. Repeat step 1 for other days of week.

HomeHospital Average Delay in ED-to-Ward transfer (hours)(by physical location), May 2006–December 2006 and April 2007-October 2007																				
	Sundays					Mondays					Tuesdays					Wednesdays				
Time	Internal Medicine A	Internal Medicine B	Internal Medicine C	Internal Medicine D	Average per A-D	Internal Medicine A	Internal Medicine B	Internal Medicine C	Internal Medicine D	average per A-D	Internal Medicine A	Internal Medicine B	Internal Medicine C	Internal Medicine D	Average per A-D	Internal Medicine A	Internal Medicine B	Internal Medicine C	Internal Medicine D	average per A-D
00:00	3.2	2.2	3.3	2.0	2.7	4.7	2.9	3.1	2.6	3.3	4.4	3.1	1.6	2.7	2.9	2.4	1.8	1.4	1.6	1.8
01:00	2.8	3.6	2.7	5.2	3.6	3.0	2.3	2.5	3.0	2.7	3.0	3.1	2.3	2.5	2.7	4.1	2.8	2.0	2.6	2.9
02:00	4.9	3.4	5.5	4.1	4.5	3.1	3.8	3.1	4.0	3.5	2.5	4.9	3.3	3.0	3.4	3.6	4.7	3.8	1.5	3.4
03:00	6.5	5.3	2.2	4.8	4.7	2.6	5.2	4.5	3.4	3.9	4.3	4.4	4.2	1.2	3.5	3.8	2.7	3.0	3.4	3.2
04:00	3.0	4.2	5.5	6.8	4.9	3.3	5.3	4.9	7.0	5.1	3.0	2.6	2.6	5.8	3.5	5.6	2.8	2.9	5.0	4.1
05:00	3.4	3.0	4.7	4.0	3.8	5.7	1.4	4.0	6.0	4.3	3.8	3.2	5.7	6.3	4.8	5.0	3.5	6.0	3.7	4.5
06:00	11.0	2.5	5.6	7.0	6.5	1.0	3.7	4.8	5.0	3.6	0.0	0.3	0.0	5.0	1.3	7.2	2.5	2.5	8.0	5.0
07:00	7.8	6.0	8.0	4.8	6.6	7.0	4.5	4.8	6.7	5.8	7.8	4.5	3.0	4.6	5.0	5.0	4.4	4.8	6.0	5.1
08:00	8.8	2.8	7.3	4.7	5.9	8.0	3.0	6.7	5.4	5.8	5.4	2.0	4.5	4.3	4.1	5.0	3.6	5.0	4.3	4.5
09:00	6.2	2.7	7.5	3.8	5.0	3.0	3.7	4.6	3.7	3.7	4.8	4.1	5.6	4.6	4.8	5.5	2.0	4.6	3.7	4.0
10:00	4.9	2.2	3.7	3.5	3.6	4.7	2.3	5.7	3.8	4.1	4.1	2.5	4.4	3.9	3.7	4.3	2.7	4.4	3.4	3.7
11:00	4.8	3.4	3.2	3.8	3.8	4.6	3.9	3.2	3.7	3.9	4.3	2.6	5.4	3.7	4.0	5.0	3.3	3.8	4.5	4.1
12:00	4.7	2.7	4.0	3.2	3.7	3.5	3.0	3.1	2.7	3.1	3.2	3.8	3.9	3.1	3.5	4.0	2.8	4.5	4.0	3.8
13:00	4.2	4.9	3.4	3.1	3.9	4.0	3.6	3.1	3.0	3.5	4.5	3.3	5.0	3.1	4.0	2.9	2.2	3.7	3.1	3.0
14:00	5.5	4.2	4.1	3.8	4.4	3.7	3.6	3.8	4.2	3.8	4.6	3.9	3.6	3.3	3.9	3.7	2.9	4.2	2.9	3.4
15:00	3.5	3.2	4.0	3.0	3.4	3.4	2.9	3.2	2.6	3.0	4.7	3.0	3.6	3.5	3.7	3.0	2.0	3.4	3.5	2.9
16:00	3.1	2.4	2.9	2.6	2.8	3.8	3.6	2.8	3.0	3.3	4.4	1.6	3.1	3.3	3.1	3.9	1.4	3.6	2.3	2.8
17:00	3.2	5.4	2.7	1.8	3.2	5.1	2.6	3.1	3.2	3.5	3.0	2.1	3.3	2.7	2.8	3.6	2.9	3.0	2.2	2.9
18:00	3.9	4.0	3.2	3.6	3.7	4.8	3.1	2.8	3.2	3.5	3.2	2.6	2.4	2.7	2.7	4.4	6.4	2.6	2.7	4.0
19:00	3.2	3.0	3.2	2.1	2.9	3.2	3.7	3.4	2.7	3.2	3.9	2.4	2.2	2.5	2.7	2.9	3.1	3.5	2.9	3.1
20:00	2.7	4.6	4.8	2.4	3.6	3.6	4.3	2.6	3.1	3.4	4.3	3.4	2.3	3.5	3.4	3.0	2.0	3.0	2.2	2.6
21:00	3.3	3.8	3.2	4.4	3.6	3.8	2.8	3.3	3.6	3.4	3.0	2.7	3.0	3.2	3.0	2.7	1.9	2.5	3.2	2.6
22:00	3.9	2.8	4.8	4.7	4.0	3.4	3.6	2.5	5.0	3.6	3.2	3.0	2.4	4.0	3.2	4.6	4.3	4.6	5.1	4.6
23:00	4.7	3.6	3.5	4.6	4.1	3.8	5.3	3.6	5.3	4.5	4.4	2.7	3.3	5.4	4.0	5.0	2.7	2.7	4.8	3.8

HomeHospital Average Delay in ED-to-Ward transfer (hours)(by physical location), May 2006–December 2006 and April 2007–October 2007															
Time	Thursdays					Fridays					Saturdays				
	Internal Medicine A	Internal Medicine B	Internal Medicine C	Internal Medicine D	average per A-D	Internal Medicine A	Internal Medicine B	Internal Medicine C	Internal Medicine D	Average per A-D	Internal Medicine A	Internal Medicine B	Internal Medicine C	Internal Medicine D	Average per A-D
00:00	2.7	1.6	1.8	4.6	2.7	2.3	2.0	1.5	2.8	2.1	2.2	4.2	1.7	2.0	2.5
01:00	3.2	2.3	2.2	1.8	2.4	2.5	2.1	1.8	1.9	2.1	2.3	2.8	2.5	1.7	2.3
02:00	4.3	3.6	3.9	3.7	3.9	3.1	3.7	2.6	1.7	2.8	2.4	3.3	2.7	1.1	2.4
03:00	3.7	3.9	3.1	2.8	3.4	2.4	2.6	2.6	1.8	2.3	1.3	3.0	3.8	1.2	2.3
04:00	5.8	4.3	5.7	4.5	5.1	3.4	5.0	4.7	1.0	3.5	2.3	2.0	3.3	3.0	2.6
05:00	5.4	1.5	4.7	10.0	5.4	6.3	1.4	5.3	3.5	4.1	4.0	3.7	3.8	0.5	3.0
06:00	3.0	4.0	1.0	5.3	3.3	2.5	1.5	3.0	0.0	1.8	5.7	0.3	4.0	6.0	4.0
07:00	7.5	4.6	6.8	0.0	4.7	6.8	4.3	5.8	2.7	4.9	6.0	4.3	6.0	7.7	6.0
08:00	8.3	3.0	5.3	4.8	5.4	6.6	2.3	2.0	5.6	4.1	4.5	3.6	4.8	4.8	4.4
09:00	6.0	2.2	4.9	3.0	4.0	4.4	2.9	3.8	3.0	3.5	4.5	2.5	4.0	4.4	3.9
10:00	5.7	2.7	4.0	4.3	4.2	4.2	2.4	3.6	2.5	3.2	3.1	1.4	3.8	2.6	2.7
11:00	5.3	2.8	3.6	3.2	3.7	3.6	1.9	2.4	2.2	2.5	3.2	1.4	2.7	2.1	2.3
12:00	4.2	2.8	4.6	3.4	3.7	2.8	1.8	2.8	1.8	2.3	3.1	3.2	2.3	2.4	2.7
13:00	4.1	4.4	4.6	3.8	4.2	3.3	3.2	2.3	2.3	2.8	2.2	2.8	1.7	2.3	2.2
14:00	4.1	3.5	3.3	3.9	3.7	3.6	1.8	2.8	3.1	2.8	3.4	1.8	3.5	2.4	2.8
15:00	3.2	2.8	3.3	2.7	3.0	2.3	1.5	1.8	2.0	1.9	2.4	3.5	3.1	3.2	3.0
16:00	3.2	2.3	3.7	2.2	2.9	1.6	2.4	1.8	1.5	1.8	1.8	4.0	3.8	4.3	3.5
17:00	3.0	3.5	2.3	2.0	2.7	2.6	1.2	2.4	1.5	1.9	4.5	2.5	3.6	3.1	3.4
18:00	3.0	2.5	2.5	1.5	2.4	1.9	1.5	2.5	1.5	1.9	2.6	3.9	3.0	3.6	3.3
19:00	3.2	2.3	2.8	1.6	2.5	2.3	1.3	2.2	1.7	1.9	4.3	2.2	3.0	2.8	3.1
20:00	3.4	2.4	2.5	1.3	2.4	2.0	2.1	2.4	1.3	1.9	1.9	2.3	2.6	1.8	2.1
21:00	4.0	2.0	2.0	3.1	2.8	2.9	1.0	2.2	2.4	2.1	2.0	3.7	4.1	2.1	3.0
22:00	2.7	2.4	2.8	3.8	2.9	2.8	1.7	1.8	3.1	2.3	2.6	2.9	1.6	5.7	3.2
23:00	3.6	2.2	2.9	3.5	3.0	2.4	2.2	2.7	2.5	2.4	4.9	3.3	4.6	4.9	4.4

3. Creating data table: click *Main* → *Statistical Models (Summaries)*. Select *Time Series*, then *Intraday*. From the variables list, select *Number of Patients in Ward (by physical location)*. In the *Categories* tab, in subcategory *physical_hospital_unit* select *Internal Medicine A*, *Internal Medicine B*, *Internal Medicine C*, *Internal Medicine D*. Open the *X Properties* tab. Select resolution *60:00* minutes. Click the *Dates* → button. Select *Dates totals only* and months from *May 2006 to December 2006 and from April 2007 to October 2007*. Open tab *Days* and select *Sundays*. Click *OK*.
4. Repeat step 3 for other days of week.

HomeHospital Number of Patients in Ward (by physical location), May 2006–December 2006 and April 2007–October 2007																				
	Sundays					Mondays					Tuesdays					Wednesdays				
Time	Internal Medicine A	Internal Medicine B	Internal Medicine C	Internal Medicine D	Average per A-D	Internal Medicine A	Internal Medicine B	Internal Medicine C	Internal Medicine D	average per A-D	Internal Medicine A	Internal Medicine B	Internal Medicine C	Internal Medicine D	Average per A-D	Internal Medicine A	Internal Medicine B	Internal Medicine C	Internal Medicine D	average per A-D
00:00	46.1	30.1	39.7	42.8	39.7	45.5	29.1	39.1	41.6	38.8	45.4	29.3	38.8	41.3	38.7	44.0	28.7	38.0	40.8	37.9
01:00	46.3	30.1	39.8	42.9	39.8	45.8	29.4	39.3	41.8	39.1	45.6	29.4	39.0	41.8	38.9	44.3	28.9	38.2	41.0	38.1
02:00	46.4	30.3	40.0	43.1	39.9	46.0	29.6	39.5	42.1	39.3	45.9	29.7	39.2	42.0	39.2	44.4	29.1	38.5	41.3	38.3
03:00	46.5	30.5	40.1	43.2	40.1	46.2	29.8	39.7	42.5	39.6	46.2	29.8	39.4	42.4	39.4	44.6	29.1	38.7	41.6	38.5
04:00	46.6	30.5	40.2	43.4	40.2	46.4	29.9	39.7	42.7	39.7	46.3	29.9	39.5	42.5	39.6	44.7	29.2	38.8	41.8	38.6
05:00	46.6	30.6	40.2	43.4	40.2	46.5	30.0	39.8	42.7	39.8	46.4	30.1	39.6	42.6	39.7	44.8	29.3	38.9	41.8	38.7
06:00	46.7	30.6	40.3	43.4	40.3	46.7	30.2	39.8	42.8	39.8	46.5	30.1	39.7	42.6	39.7	44.9	29.4	38.9	41.9	38.8
07:00	46.7	30.7	40.3	43.5	40.3	46.7	30.3	39.8	42.7	39.9	46.4	30.2	39.7	42.7	39.7	45.0	29.5	38.9	41.9	38.8
08:00	46.7	30.7	40.5	43.6	40.4	46.8	30.3	39.8	42.8	39.9	46.5	30.2	39.7	42.8	39.8	45.0	29.5	38.9	42.0	38.9
09:00	46.8	30.8	40.6	43.5	40.4	46.8	30.3	39.9	42.8	40.0	46.6	30.3	39.8	42.8	39.9	45.1	29.8	39.0	42.1	39.0
10:00	47.0	30.9	40.6	43.7	40.6	46.8	30.3	40.1	43.0	40.1	46.6	30.5	40.0	42.9	40.0	45.2	29.8	39.2	42.3	39.1
11:00	47.3	31.1	40.8	43.8	40.8	46.8	30.4	40.3	43.2	40.2	46.7	30.6	40.2	43.0	40.1	45.3	29.9	39.4	42.5	39.3
12:00	47.3	31.2	41.1	43.9	40.9	47.0	30.6	40.4	43.1	40.3	46.4	30.5	40.4	43.0	40.1	45.3	30.0	39.6	42.4	39.3
13:00	47.4	31.2	41.4	43.9	41.0	47.1	30.5	40.5	43.1	40.3	46.3	30.3	40.6	43.0	40.0	45.1	29.9	39.5	42.4	39.2
14:00	47.4	31.0	41.6	44.1	41.0	47.0	29.9	40.3	43.2	40.1	46.3	30.3	40.6	43.0	40.1	45.0	29.6	39.7	42.3	39.2
15:00	47.0	30.5	40.8	42.8	40.2	46.0	29.5	39.9	42.0	39.3	45.7	29.2	39.6	41.7	39.1	44.4	28.6	39.1	40.8	38.2
16:00	44.4	28.2	38.4	38.9	37.5	44.5	28.5	38.2	39.1	37.6	43.5	27.8	37.5	39.2	37.0	42.2	27.1	37.3	38.2	36.2
17:00	43.4	27.6	37.8	38.4	36.8	43.7	28.0	37.6	38.8	37.0	42.8	27.1	37.1	38.7	36.4	41.6	26.6	36.8	38.0	35.8
18:00	43.0	27.6	37.3	38.7	36.6	43.4	27.8	37.3	38.7	36.8	42.6	26.7	36.9	38.5	36.2	41.4	26.6	36.2	37.8	35.5

19:00	43.1	27.7	37.5	39.0	36.8	43.3	27.7	37.1	38.6	36.7	42.7	26.8	36.8	38.8	36.3	41.4	26.4	36.0	37.9	35.4
20:00	43.4	27.7	37.7	39.4	37.0	43.7	27.8	36.9	39.1	36.9	42.9	26.9	36.9	39.1	36.4	41.4	26.5	35.9	38.3	35.5
21:00	43.7	27.9	37.8	40.0	37.3	44.0	27.9	37.2	39.6	37.2	43.0	27.2	36.8	39.3	36.6	41.7	26.8	35.9	38.6	35.8
22:00	44.0	28.3	38.1	40.5	37.7	44.5	28.3	37.8	40.1	37.6	43.0	27.5	37.0	39.8	36.8	42.0	27.1	36.2	39.0	36.1
23:00	44.4	28.5	38.3	40.8	38.0	44.6	28.3	38.1	40.5	37.9	43.3	27.8	37.1	40.1	37.1	42.3	27.3	36.4	39.3	36.3
00:00	45.3	29.1	39.0	41.6	38.8	45.3	29.1	38.8	41.1	38.6	44.2	28.8	37.9	40.8	37.9	43.1	27.9	37.0	39.8	36.9

HomeHospital Number of Patients in Ward (by physical location), May 2006–December 2006 and April 2007–October 2007															
Time	Thursdays					Fridays					Saturdays				
	Internal Medicine A	Internal Medicine B	Internal Medicine C	Internal Medicine D	average per A-D	Internal Medicine A	Internal Medicine B	Internal Medicine C	Internal Medicine D	Average per A-D	Internal Medicine A	Internal Medicine B	Internal Medicine C	Internal Medicine D	Average per A-D
00:00	43.7	28.2	37.5	40.4	37.5	41.1	27.0	36.2	38.2	35.6	41.8	26.1	36.8	38.8	35.9
01:00	43.8	28.5	37.8	40.6	37.7	41.4	27.3	36.6	38.5	35.9	42.1	26.2	36.9	38.9	36.0
02:00	44.2	28.8	38.1	41.0	38.0	41.6	27.5	36.8	38.9	36.2	42.3	26.4	37.0	39.3	36.3
03:00	44.4	29.0	38.3	41.4	38.3	41.8	27.7	37.0	39.3	36.5	42.4	26.5	37.2	39.5	36.4
04:00	44.4	29.1	38.4	41.6	38.4	41.9	27.8	37.2	39.5	36.6	42.5	26.5	37.2	39.5	36.4
05:00	44.5	29.2	38.5	41.6	38.5	42.0	27.7	37.2	39.5	36.6	42.6	26.6	37.3	39.7	36.5
06:00	44.6	29.3	38.5	41.6	38.5	42.0	27.8	37.3	39.5	36.7	42.6	26.6	37.4	39.7	36.6
07:00	44.6	29.4	38.5	41.7	38.5	42.0	27.9	37.4	39.5	36.7	42.7	26.6	37.4	39.7	36.6
08:00	44.6	29.4	38.6	41.7	38.6	42.1	28.0	37.4	39.6	36.8	42.7	26.7	37.4	39.7	36.6
09:00	44.7	29.5	38.6	41.5	38.6	42.2	28.0	37.4	39.6	36.8	42.8	26.8	37.6	40.0	36.8
10:00	44.8	29.5	38.8	41.5	38.6	42.2	28.1	37.5	39.7	36.9	42.9	26.8	37.6	40.0	36.9
11:00	45.0	29.7	38.9	41.7	38.8	42.3	28.0	37.6	39.6	36.9	43.0	26.9	37.7	40.2	37.0
12:00	45.0	29.5	39.0	41.8	38.8	42.3	27.3	37.3	39.5	36.6	43.1	27.1	37.7	40.3	37.0
13:00	45.0	29.5	39.0	41.8	38.8	42.0	26.7	36.7	39.2	36.1	43.3	27.2	37.6	40.4	37.1
14:00	44.9	29.0	38.9	41.9	38.7	41.7	25.8	36.2	38.7	35.6	43.5	27.3	37.7	40.6	37.3
15:00	44.5	28.1	38.2	40.7	37.9	41.3	25.0	35.4	38.0	34.9	43.7	27.5	37.6	40.6	37.4
16:00	41.6	26.1	36.4	37.2	35.4	40.3	24.3	34.9	36.9	34.1	43.7	27.7	37.7	40.7	37.4
17:00	40.1	25.4	35.2	36.8	34.4	40.1	24.1	35.0	37.0	34.0	44.1	28.0	37.8	40.9	37.7
18:00	39.7	25.2	34.6	36.5	34.0	40.3	24.2	35.1	37.2	34.2	44.4	28.2	37.9	41.1	37.9
19:00	39.6	25.3	34.5	36.7	34.0	40.5	24.4	35.2	37.3	34.3	44.7	28.5	38.2	41.3	38.2
20:00	39.7	25.4	34.5	36.8	34.1	40.7	24.7	35.5	37.7	34.6	45.0	28.8	38.3	41.6	38.4
21:00	39.9	25.5	34.7	37.2	34.3	40.9	24.7	35.7	37.9	34.8	45.3	29.0	38.6	41.8	38.7
22:00	40.1	25.8	34.9	37.5	34.5	41.1	25.0	35.9	38.3	35.1	45.7	29.3	38.8	42.0	39.0
23:00	40.3	26.0	35.2	37.5	34.8	41.3	25.3	36.3	38.5	35.3	45.9	29.4	39.0	42.2	39.1
00:00	41.2	26.9	36.2	38.2	35.6	41.7	25.8	36.8	38.8	35.8	46.2	30.0	39.5	42.6	39.6

5. Compute averages per day and per IW.

	Average Delay in ED-to-Ward transfer (hours) A-D (by physical location)	Number of Patients in Ward (average) A-D (by physical location)
Sundays	4.12	39.29
Mondays	3.81	38.89
Tuesdays	3.48	38.59
Wednesdays	3.58	37.74
Thursdays	3.51	37.01
Fridays	2.62	35.75
Saturdays	3.14	37.31

6. Create chart of averages per day of week.

Reproducing steps (2):

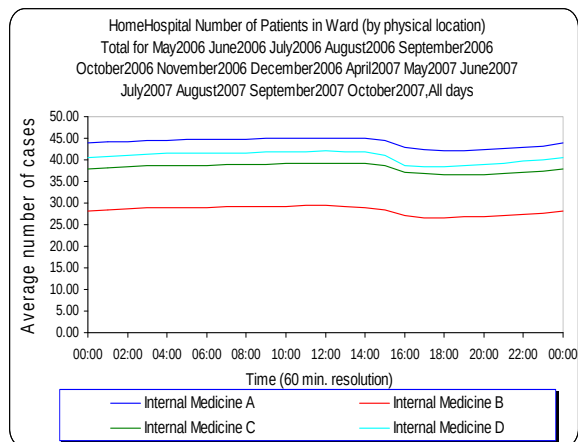
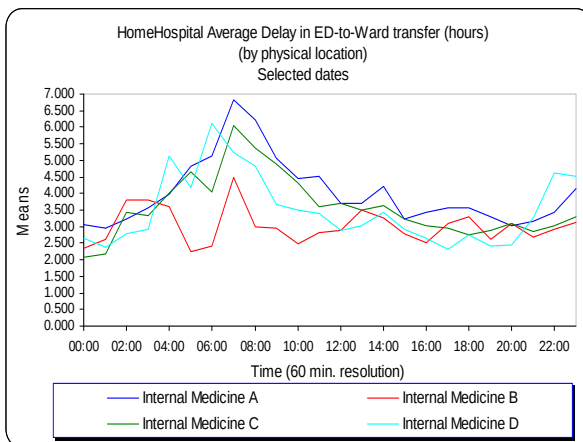
1. Creating data table: click *Main* → *Statistical Models (Summaries)*. Select *Time Series*, then *Intraday*. From the variables list, select *Average Delay in ED-to-Ward transfer (hours)(by physical location)*. In the *Categories* tab, select *Internal Medicine A*, *Internal Medicine B*, *Internal Medicine C*, *Internal Medicine D*. Open the *X Properties* tab. Select resolution *60:00* minutes.

Click the *Dates* → button. Select *Dates totals only* and months from *May 2006 to December 2006 and from April 2007 to October 2007*. Open tab *Days* and select *All days*. Click *OK*.

- Repeat step 1 for *Number of Patients in Ward (by physical location)* variable.
- Compute averages per IW A–D.

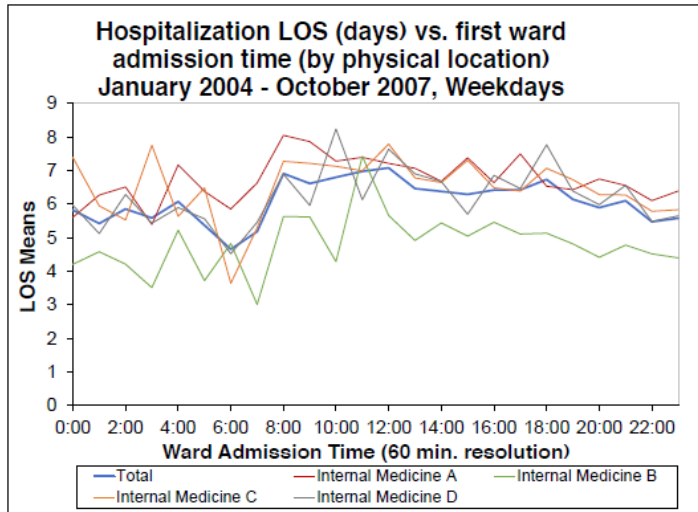
Time	Average Delay in ED-to-Ward transfer (hours)(by physical location)					Number of Patients in Ward (by physical location)				
	Internal Medicine A	Internal Medicine B	Internal Medicine C	Internal Medicine D	average per A–D	Internal Medicine A	Internal Medicine B	Internal Medicine C	Internal Medicine D	average per A–D
00:00	3.1	2.3	2.1	2.6	2.5	43.9	28.3	38.0	40.5	37.7
01:00	3.0	2.6	2.2	2.4	2.5	44.1	28.5	38.2	40.8	37.9
02:00	3.2	3.8	3.4	2.8	3.3	44.3	28.7	38.4	41.1	38.1
03:00	3.6	3.8	3.3	2.9	3.4	44.5	28.8	38.6	41.4	38.3
04:00	4.0	3.6	4.0	5.1	4.2	44.6	28.9	38.7	41.5	38.4
05:00	4.8	2.2	4.7	4.2	4.0	44.7	29.0	38.8	41.6	38.5
06:00	5.1	2.4	4.0	6.1	4.4	44.7	29.1	38.8	41.6	38.6
07:00	6.8	4.5	6.1	5.2	5.7	44.8	29.1	38.8	41.6	38.6
08:00	6.2	3.0	5.4	4.8	4.9	44.8	29.2	38.9	41.7	38.6
09:00	5.1	3.0	4.9	3.7	4.1	44.9	29.2	39.0	41.7	38.7
10:00	4.5	2.5	4.3	3.5	3.7	45.0	29.3	39.1	41.8	38.8
11:00	4.5	2.8	3.6	3.4	3.6	45.1	29.4	39.2	42.0	38.9
12:00	3.7	2.9	3.7	2.9	3.3	45.1	29.4	39.3	42.0	38.9
13:00	3.7	3.5	3.5	3.0	3.4	45.1	29.3	39.3	41.9	38.9
14:00	4.2	3.3	3.6	3.4	3.6	45.0	28.9	39.3	42.0	38.8
15:00	3.2	2.8	3.2	2.9	3.1	44.6	28.3	38.6	41.0	38.1
16:00	3.4	2.5	3.0	2.7	2.9	42.9	27.1	37.2	38.7	36.5
17:00	3.6	3.1	3.0	2.3	3.0	42.3	26.7	36.8	38.5	36.1
18:00	3.6	3.3	2.8	2.7	3.1	42.1	26.6	36.5	38.5	35.9
19:00	3.3	2.6	2.9	2.4	2.8	42.2	26.7	36.5	38.6	36.0
20:00	3.0	3.1	3.1	2.5	2.9	42.4	26.9	36.6	39.0	36.2
21:00	3.2	2.7	2.9	3.3	3.0	42.6	27.1	36.7	39.3	36.4
22:00	3.4	2.9	3.0	4.6	3.5	42.9	27.4	37.0	39.7	36.8
23:00	4.1	3.1	3.3	4.5	3.8	43.2	27.6	37.3	39.9	37.0

Original SEEStat charts:



- Create chart of averages. Add and format secondary vertical axis for *Number of Patients in Ward (by physical location)*, format primary vertical axis. (See in [Appendix 5](#) How to add a secondary vertical axis in Excel.)

Fig 17: ALOS in IWs A through D, as a function of ward admission-time

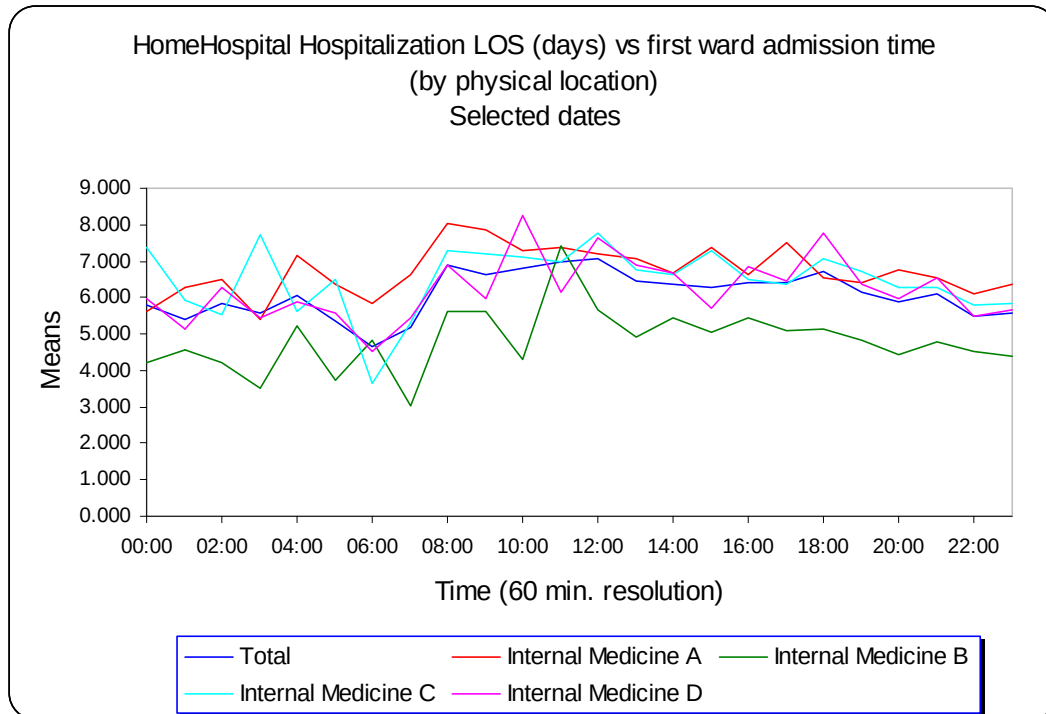


Reproducing steps:

1. Creating chart:

Click *Main* → *Statistical Models (Summaries)*. Select *Time Series*, then *Intraday*. From the variables list, select *Hospitalization LOS (days) vs first ward admission time (by physical location)*. In the *Select Categories* tab, select all categories including *Total*. Click the *Dates* → button. Select *Dates totals only* and all months from *January 2004* to *October 2007*. Open tab *Days* and select *Weekdays*. Click *OK*.

Original SEESat chart:

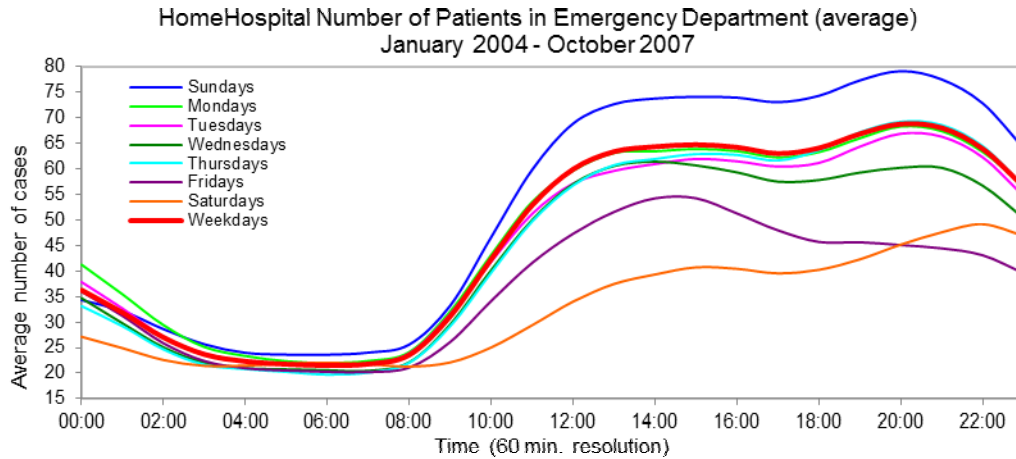


2. Design the original SEESat chart:

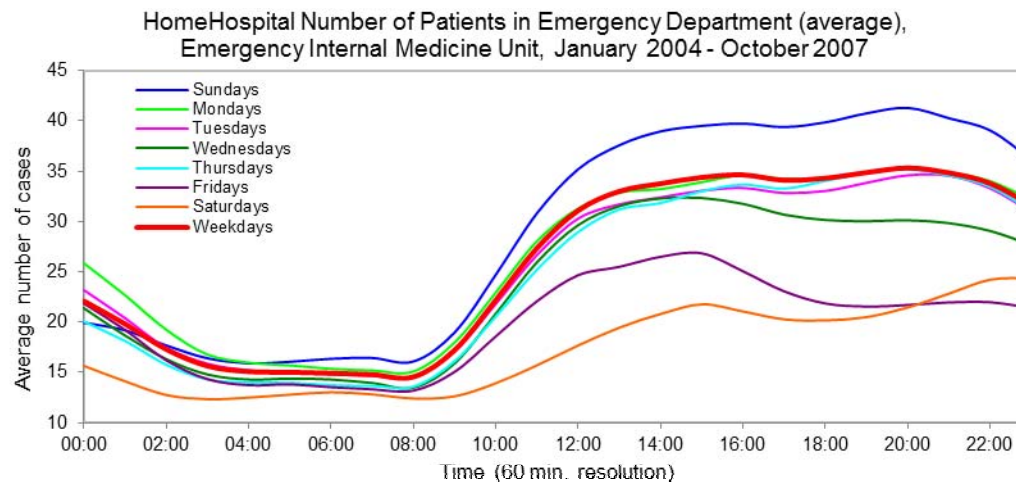
Change in the chart title *Selected dates* to *January 2004 – October 2007, Weekdays*

Appendix 1: Number of patients in ED by day-of-week

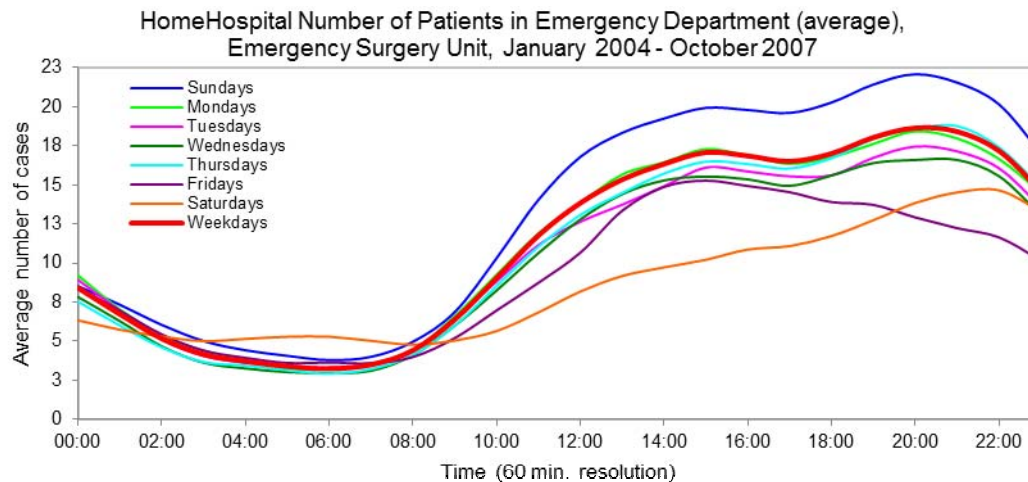
Average number of Patients in ED Total, by day-of-week



Average number of Patients in ED Internal Medicine, by day-of-week



Average number of Patients in ED Surgery, by day-of-week



Appendix 2: Arrivals and service rates

2.1 Short description

Reference: Whitt W., *Fitting birth-and-death queueing models to data*, Statistics and Probability Letters 82 (2012) 998–1004 <http://www.columbia.edu/~ww2040/FitBD021112.pdf>

1000

W. Whitt / Statistics and Probability Letters 82 (2012) 998–1004

3. Fitting the BD model to queueing system data

Consider a queueing system in which arrivals and departures occur one at a time. Let $X(s)$ be the number of customers in the system at time s . We now consider fitting a BD model to data collected over an interval $[0, t]$.

Let $\bar{\lambda}_i(t)$ and $\bar{\mu}_i(t)$ be natural direct estimates of the birth rates and death rates based on sample averages over the time interval $[0, t]$. Similarly, let $\bar{\alpha}_i(t)$ be natural direct estimates of the stationary distribution based on sample averages over the time interval $[0, t]$.

In particular, let $A_i(t)$ be the number of arrivals during the interval $[0, t]$ when the system is in state i ; let $D_i(t)$ be the number of departures during the interval $[0, t]$ when the system is in state i ; and let $T_i(t)$ be the total time during the interval $[0, t]$ in which the system is in state i ; i.e.,

$$T_i(t) \equiv \int_0^t 1_{\{X(s)=i\}} ds, \quad t \geq 0, \quad (6)$$

where 1_A is the indicator function of the set A , equal to 1 on A and equal to 0 otherwise. Then let

$$\bar{\lambda}_i(t) \equiv \frac{A_i(t)}{T_i(t)}, \quad \bar{\mu}_i(t) \equiv \frac{D_i(t)}{T_i(t)} \quad \text{and} \quad \bar{\alpha}_i(t) \equiv \frac{T_i(t)}{t}, \quad t \geq 0. \quad (7)$$

time interval – over 24 hours of day or 10 hours from 12:00:00 to 21:59:59

state i – Internal ED and Surgical ED and Traumatology ED state or Internal ED state (number of patients)

Weighted average arrival and service rates for each system state over the entire period:

$$\bar{\lambda}_i = \frac{\sum_1^n (\lambda_i * T_i)}{\sum_1^n T_i} = \frac{\sum_1^n (A_i / T_i * T_i)}{\sum_1^n T_i} = \frac{\sum_1^n A_i}{\sum_1^n T_i}$$

$$\bar{\mu}_i = \frac{\sum_1^n (\mu_i * T_i)}{\sum_1^n T_i} = \frac{\sum_1^n (D_i / T_i * T_i)}{\sum_1^n T_i} = \frac{\sum_1^n D_i}{\sum_1^n T_i}$$

n - number of days over the entire period when the system was in state i

Computing steps:

1. For each time interval (e.g. over 24 hours of day, over 6 hours from 03:00:00 to 08:59:59, over 3 hours from 09:00:00 to 11:59:59, over 10 hours from 12:00 to 21:59:59, over 5 hours from 22:00:00 to 02:59:59) compute the number of patients in ED, duration of ED state, number of arrivals, number of departures.
2. Aggregate data by number of patients in the ED for each day of each month.
3. Append the calculations of all time-periods (from step 2), between January 2004 to October 2007.
4. Sum the duration of ED state, number of arrivals, number of departures for each ED state over the entire period and compute the arrival rate and departures rate.

The following table demonstrates the application of Steps 1, 2 and 3.

year month	Day of month (time interval)	Internal ED state (# of patients) state i	Arrivals A_i	Departures D_i	state duration (seconds) T_i
200401	1	4	1	0	360
200401	1	5	1	0	2700
200401	1	6	2	0	6780
200401	1	7	2	1	2760
200401	1	8	2	1	1680
200401	1	9	3	1	5880
200401	1	10	4	3	2340
200401	1	11	5	2	5940
200401	1	12	3	4	1800
200401	1	13	1	2	1380
200401	1	14	2	0	540
200401	1	15	1	1	1619
200401	1	16	3	0	1080
200401	1	17	2	2	660
200401	1	18	1	1	120
200401	1	19	2	5	660
200401	1	20	2	0	420
200401	1	21	2	1	1080
200401	1	22	5	0	1440
200401	1	23	4	8	1920
200401	1	24	3	0	2280
200401	1	25	3	6	1680
200401	1	26	9	6	3900
200401	1	27	8	5	5640
200401	1	28	8	8	4860
200401	1	29	6	9	2880
200401	1	30	13	3	6390
200401	1	31	4	18	4770
200401	1	32	2	4	2100
200401	1	33	6	3	4260
200401	1	34	3	4	1920
200401	1	35	4	4	1500
200401	1	36	0	2	360
200401	1	37	1	3	300
200401	2	15	1	0	421
200401	2	16	2	0	1380
200401	2	17	2	0	960
200401	2	18	6	3	5081
200401	2	19	5	4	5771
200401	2	20	2	4	5092
200401	2	21	3	1	6941
200401	2	22	2	4	1248
200401	2	23	3	1	2990
200401	2	24	2	2	3380
200401	2	25	2	1	2407
200401	2	26	7	1	1965
200401	2	27	7	11	5057
200401	2	28	12	7	8185
200401	2	29	9	12	6634
200401	2	30	3	9	4339
200401	2	31	2	3	2200
200401	2	32	3	3	886
200401	2	33	2	2	1056
200401	2	34	3	2	602
...					

The following table demonstrates the application of Step 4.

Internal ED state (# of patients) <i>state i</i>	arrivals over all period $\sum_1^n A_i$	departures over all period $\sum_1^n D_i$	state duration in seconds over all period $\sum_1^n T_i$	arrival rate per hour $\bar{\lambda}_i = \frac{\sum_1^n A_i}{\sum_1^n T_i / 3600}$	service rate per hour $\bar{\mu}_i = \frac{\sum_1^n D_i}{\sum_1^n T_i / 3600}$
0	3	0	1715	6.30	0.00
1	25	2	54248	1.66	0.13
2	52	23	92002	2.03	0.90
3	95	51	167062	2.05	1.10
4	173	91	312275	1.99	1.05
5	341	170	530234	2.32	1.15
6	589	335	870706	2.44	1.39
7	880	585	1275834	2.48	1.65
8	1250	856	1725071	2.61	1.79
9	1740	1237	2272070	2.76	1.96
10	2326	1717	2880951	2.91	2.15
11	2942	2290	3540511	2.99	2.33
12	3496	2913	4104873	3.07	2.55
13	4033	3434	4461837	3.25	2.77
14	4417	3965	4576525	3.47	3.12
15	4750	4336	4678464	3.66	3.34
16	5089	4666	4722544	3.88	3.56
17	5382	4996	4523729	4.28	3.98
18	5759	5255	4681622	4.43	4.04
19	5898	5690	4565042	4.65	4.49
20	5997	5756	4295319	5.03	4.82
21	6034	5895	4053159	5.36	5.24
22	6259	5929	3954108	5.70	5.40
23	6162	6246	3784202	5.86	5.94
24	6085	6084	3646008	6.01	6.01
25	6264	6025	3486727	6.47	6.22
26	6338	6198	3410481	6.69	6.54
27	6328	6342	3265748	6.98	6.99
28	6322	6324	3217029	7.07	7.08
29	6079	6333	3146357	6.96	7.25
30	6135	6119	2965311	7.45	7.43
31	6042	6161	2911314	7.47	7.62
32	5974	6073	2821100	7.62	7.75
33	5617	5996	2692626	7.51	8.02
34	5309	5652	2501983	7.64	8.13
35	5009	5470	2335307	7.72	8.43
36	4714	5066	2157050	7.87	8.45
37	4548	4788	2006762	8.16	8.59
38	4168	4588	1881416	7.98	8.78
39	3682	4166	1692032	7.83	8.86
40	3257	3710	1490277	7.87	8.96
41	2944	3321	1288820	8.22	9.28
42	2682	3039	1152253	8.38	9.49
43	2354	2796	1038116	8.16	9.70
44	2089	2446	919989	8.17	9.57
45	1853	2169	806044	8.28	9.69
46	1504	1883	671176	8.07	10.10
47	1418	1562	580918	8.79	9.68
48	1236	1477	508598	8.75	10.45
49	1061	1248	447889	8.53	10.03
50	866	1076	368520	8.46	10.51
51	749	860	312870	8.62	9.90
52	604	766	260244	8.36	10.60
53	481	629	200618	8.63	11.29
54	391	518	162505	8.66	11.48
55	308	406	129398	8.57	11.30

56	234	302	102914	8.19	10.56
57	166	258	85152	7.02	10.91
58	126	171	53084	8.54	11.60
59	91	125	36794	8.90	12.23
60	60	101	23950	9.02	15.18
61	41	71	17842	8.27	14.33
62	35	41	16145	7.80	9.14
63	29	35	10449	9.99	12.06
64	10	29	6401	5.62	16.31
65	7	10	2055	12.26	17.52
66	4	7	2835	5.08	8.89
67	2	4	2007	3.59	7.17
68	1	2	319	11.29	22.57
69	1	1	240	15.00	15.00
70	0	1	269	0.00	13.38

The following is a demonstration for calculating arrival/departure rates over one day (from Step 2) for the emphasized (blue) record:

$$\begin{aligned}\mu_{30, \text{January 1, 2004}} &= 3/(6390\text{sec}/3600\text{sec}) = 1.69 \text{ per hour} \\ \lambda_{30, \text{January 1, 2004}} &= 13/(6390\text{sec}/3600\text{sec}) = 7.32 \text{ per hour} \\ \mu_{30, \text{January 2, 2004}} &= 9/(4339\text{sec}/3600\text{sec}) = 7.47 \text{ per hour} \\ \lambda_{30, \text{January 2, 2004}} &= 3/(4339\text{sec}/3600\text{sec}) = 2.49 \text{ per hour}\end{aligned}$$

The following demonstrates the weighted average arrivals and service rates per hour, over two days, given that the Internal ED was populated by 30 patients (similarly to Step 4):

$$\begin{aligned}\mu_{30} &= (D_{30, \text{January 1, 2004}} + D_{30, \text{January 2, 2004}}) / ((T_{30, \text{January 1, 2004}} + T_{30, \text{January 2, 2004}}) / 3600) = \\ &= (3+9) / ((6390\text{sec}+4339\text{sec})/3600\text{sec}) = 4.03 \text{ per hour} \\ \lambda_{30} &= (A_{30, \text{January 1, 2004}} + A_{30, \text{January 2, 2004}}) / ((T_{30, \text{January 1, 2004}} + T_{30, \text{January 2, 2004}}) / 3600) = (13+3) / \\ &= ((6390\text{sec}+4339\text{sec})/3600\text{sec}) = 5.37 \text{ per hour}\end{aligned}$$

The arrival and service rates are created in SEESat as a new table and saved in binary format using dbprocedures.

The name of SEESat table for the daily average Internal ED arrival and service rates over 24 hours per day for all days in period January 2004-October 2007 is

“Internal_ED_rates_2004_2007” (source table: *visit_details*, where *entry_group=1* and *department=I*).

Internal ED arrival and service rates, January 2004-October 2007, All days	SEESat DB Table name
over 24 hours per day	Internal_ED_rates_2004_2007
over 6 hours of day, from 03:00:00 to 08:59:59	Internal_ED_rates_2004_2007_3AM_9AM
over 3 hours of day, from 09:00:00 to 11:59:59	Internal_ED_rates_2004_2007_9AM_12PM
over 10 hours of day, from 12:00:00 to 21:59:59	Internal_ED_rates_2004_2007_12_22PM
over 5 hours of day, from 22:00:00 to 02:59:59	Internal_ED_rates_2004_2007_22PM_3AM

See [Appendix 4](#) on how to export these tables from SEESat

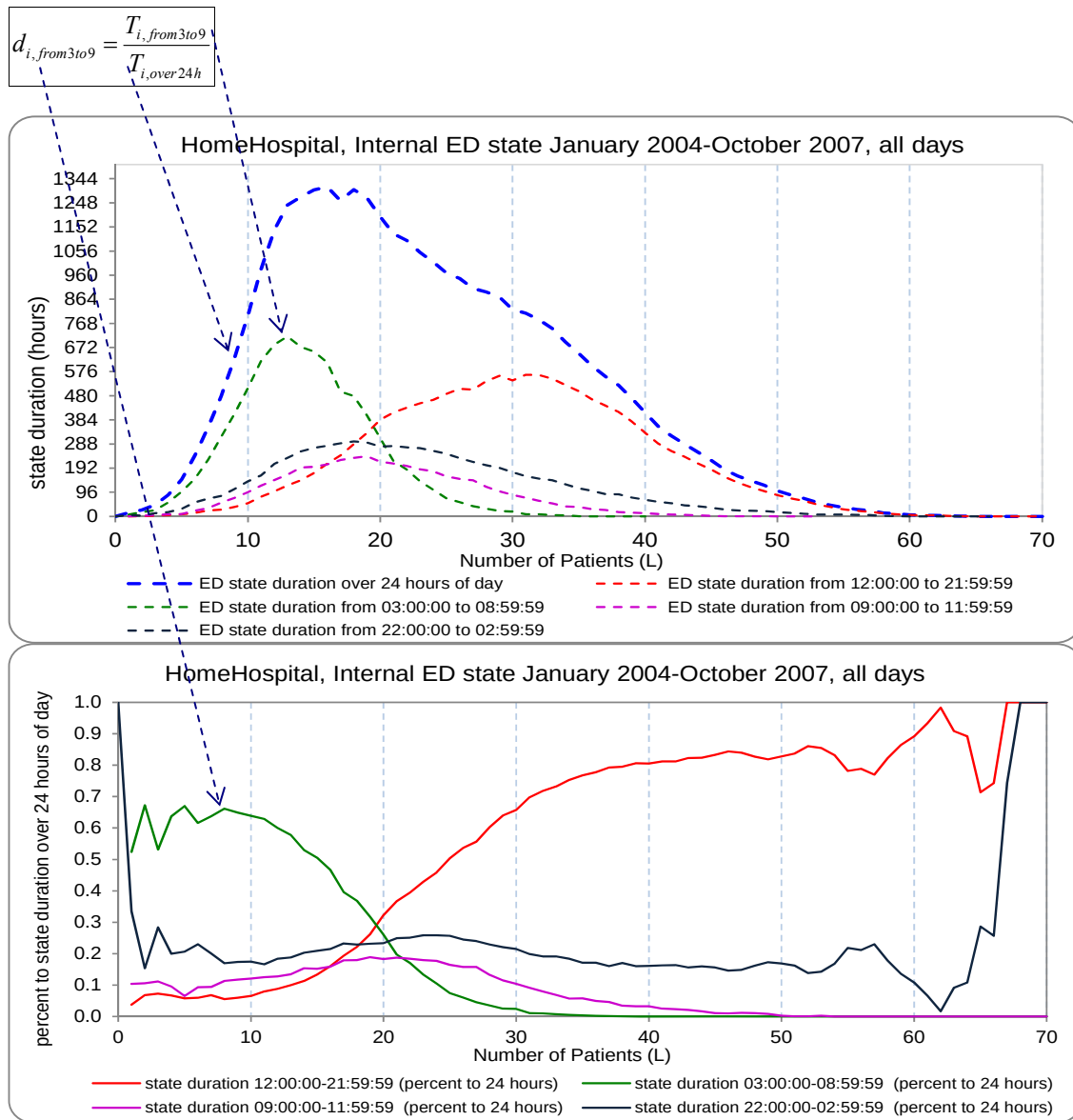
1.2 Calculations over part of day

$$\bar{\mu}_{i,from3to9} = \frac{D_{i,from3to9}}{T_{i,from3to9}}; \quad \bar{\mu}_{i,from9to12} = \frac{D_{i,from9to12}}{T_{i,from9to12}}; \quad \bar{\mu}_{i,from12to22} = \frac{D_{i,from12to22}}{T_{i,from12to22}}; \quad \bar{\mu}_{i,from22to03} = \frac{D_{i,from22to03}}{T_{i,from22to03}}$$

$$\bar{\mu}_{i,over24h} = \frac{D_{i,over24h}}{T_{i,over24h}} = \frac{D_{i,from3to9} + D_{i,from9to12} + D_{i,from12to22} + D_{i,from22to03}}{T_{i,over24h}} =$$

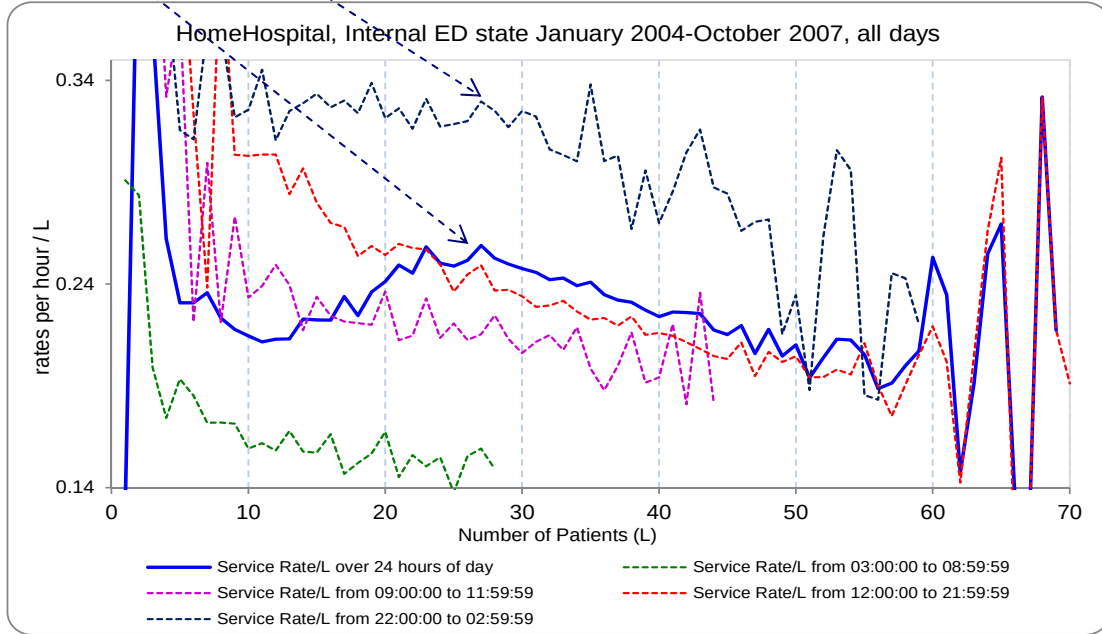
$$\frac{\mu_{i,from3to9} * T_{i,from3to9} + \mu_{i,from9to12} * T_{i,from9to12} + \mu_{i,from12to22} * T_{i,from12to22} + \mu_{i,from22to03} * T_{i,from22to03}}{T_{i,over24h}} =$$

$$\mu_{i,from3to9} * \frac{T_{i,from3to9}}{T_{i,over24h}} + \mu_{i,from9to12} * \frac{T_{i,from9to12}}{T_{i,over24h}} + \mu_{i,from12to22} * \frac{T_{i,from12to22}}{T_{i,over24h}} + \mu_{i,from22to03} * \frac{T_{i,from22to03}}{T_{i,over24h}}$$



$$\bar{\mu}_{i,over24h} = \mu_{i,from3to9} * d_{i,from3to9} + \mu_{i,from9to12} * d_{i,from9to12} + \mu_{i,from12to22} * d_{i,from12to22} + \mu_{i,from22to03} * d_{i,from22to03}$$

$$\bar{\mu}_{i,over24h} = \sum \mu_{i,partOfDay} * d_{i,partOfDay}$$



Internal ED, January 2004 - October 2007, all days

number of patients	over 24 hours of day				over 6 hours of day, from 03:00:00 to 08:59:59				over 3 hours of day, from 09:00:00 to 11:59:59				over 10 hours of day, from 12:00:00 to 21:59:59				over 5 hours of day, from 22:00:00 to 02:59:59							
	departures	state duration (hours)	service rate per hour	service rate per hour/L	departures	state duration (hours)	service rate per hour	service rate per hour/L	state duration (hours) percent to 24 hours	departures	state duration (hours)	service rate per hour	service rate per hour/L	state duration (hours) percent to 24 hours	departures	state duration (hours)	service rate per hour	service rate per hour/L	state duration (hours) percent to 24 hours	departures	state duration (hours)	service rate per hour	service rate per hour/L	state duration (hours) percent to 24 hours
0	0	0.48																		0	0.48	0		1
1	2	15.07	0.13	0.133	0	7.89	0	0	0.524	0	1.56	0	0	0.104	0	0.57	0	0	0.038	2	5.05	0.4	0.396	0.335
2	23	25.56	0.9	0.45	10	17.18	0.58	0.291	0.672	2	2.7	0.74	0.371	0.106	3	1.75	1.72	0.859	0.068	8	3.93	2.04	1.018	0.154
3	51	46.41	1.1	0.366	21	24.68	0.85	0.284	0.532	7	5.18	1.35	0.45	0.112	8	3.38	2.37	0.789	0.073	15	13.17	1.14	0.38	0.284
4	91	86.74	1.05	0.262	44	55.25	0.8	0.199	0.637	11	8.28	1.33	0.332	0.095	9	5.86	1.54	0.384	0.068	27	17.35	1.56	0.389	0.200
5	170	147.29	1.15	0.231	86	98.68	0.87	0.174	0.670	18	9.59	1.88	0.375	0.065	18	8.59	2.1	0.419	0.058	48	30.42	1.58	0.316	0.207
6	335	241.86	1.39	0.231	173	149.15	1.16	0.193	0.617	30	22.58	1.33	0.221	0.093	28	14.42	1.94	0.324	0.060	104	55.72	1.87	0.311	0.230
7	585	354.4	1.65	0.236	293	225.92	1.3	0.185	0.637	70	33.4	2.1	0.299	0.094	40	23.98	1.67	0.238	0.068	182	71.1	2.56	0.366	0.201
8	856	479.19	1.79	0.223	436	317	1.38	0.172	0.662	96	54.2	1.77	0.221	0.113	86	26.56	3.24	0.405	0.055	238	81.42	2.92	0.365	0.170
9	1237	631.13	1.96	0.218	634	409.6	1.55	0.172	0.649	182	74.02	2.46	0.273	0.117	103	37.72	2.73	0.303	0.060	318	109.79	2.9	0.322	0.174
10	1717	800.26	2.15	0.215	877	511.2	1.72	0.172	0.639	226	96.82	2.33	0.233	0.121	159	52.48	3.03	0.303	0.066	455	139.76	3.26	0.326	0.175
11	2290	983.48	2.33	0.212	1083	618.36	1.75	0.159	0.629	323	122.82	2.63	0.239	0.125	263	78.74	3.34	0.304	0.080	621	163.56	3.8	0.345	0.166
12	2913	1140.24	2.55	0.213	1331	684.93	1.94	0.162	0.601	435	145.28	2.99	0.25	0.127	365	100.2	3.64	0.304	0.088	782	209.84	3.73	0.311	0.184
13	3434	1239.4	2.77	0.213	1473	716.02	2.06	0.158	0.578	518	166.28	3.12	0.24	0.134	457	123.71	3.69	0.284	0.100	986	233.39	4.22	0.325	0.188
14	3965	1271.26	3.12	0.223	1584	674.03	2.35	0.168	0.530	593	194.87	3.04	0.217	0.153	598	143.9	4.16	0.297	0.113	1190	258.46	4.6	0.329	0.203
15	4336	1299.57	3.34	0.222	1554	656.59	2.37	0.158	0.505	691	197.05	3.51	0.234	0.152	730	173.82	4.2	0.28	0.134	1361	272.11	5	0.333	0.209
16	4666	1311.82	3.56	0.222	1540	612.33	2.51	0.157	0.467	746	207.79	3.59	0.224	0.158	908	210.16	4.32	0.27	0.160	1472	281.54	5.23	0.327	0.215
17	4996	1256.59	3.98	0.234	1407	497.55	2.83	0.166	0.396	845	224.34	3.77	0.222	0.179	1107	242.98	4.56	0.268	0.193	1637	291.72	5.61	0.33	0.232
18	5255	1300.45	4.04	0.224	1267	479.57	2.64	0.147	0.369	929	233.67	3.98	0.221	0.180	1319	288.71	4.57	0.254	0.222	1740	298.51	5.83	0.324	0.230
19	5690	1268.07	4.49	0.236	1164	402.51	2.89	0.152	0.317	1002	239.68	4.18	0.22	0.189	1631	331.77	4.92	0.259	0.262	1893	294.11	6.44	0.339	0.232
20	5756	1193.14	4.82	0.241	978	311.77	3.14	0.157	0.261	1033	218.57	4.73	0.236	0.183	1954	384.29	5.08	0.254	0.322	1791	278.52	6.43	0.322	0.233
21	5895	1125.88	5.24	0.249	780	221.72	3.52	0.168	0.197	939	210.44	4.46	0.212	0.187	2253	413	5.46	0.26	0.367	1923	280.72	6.85	0.326	0.249
22	5929	1098.36	5.4	0.245	598	187.13	3.2	0.145	0.170	954	201.99	4.72	0.215	0.184	2457	433.29	5.67	0.258	0.394	1920	275.95	6.96	0.316	0.251
23	6246	1051.17	5.94	0.258	503	140.13	3.59	0.156	0.133	1010	188.5	5.36	0.233	0.179	2663	450.64	5.91	0.257	0.429	2070	271.9	7.61	0.331	0.259
24	6084	1012.78	6.01	0.25	385	106.55	3.61	0.151	0.105	922	179.8	5.13	0.214	0.178	2784	464.71	5.99	0.25	0.459	1993	261.72	7.62	0.317	0.258
25	6025	968.54	6.22	0.249	279	72.02	3.87	0.155	0.074	880	159.5	5.52	0.221	0.165	2882	487.89	5.91	0.236	0.504	1984	249.12	7.96	0.319	0.257
26	6198	947.36	6.54	0.252	205	57.23	3.58	0.138	0.060	827	149.61	5.53	0.213	0.158	3233	508.23	6.36	0.245	0.536	1933	232.28	8.32	0.32	0.245
27	6342	907.15	6.99	0.259	172	40.98	4.2	0.155	0.045	833	143.27	5.81	0.215	0.158	3397	504.92	6.73	0.249	0.557	1940	217.98	8.9	0.33	0.240
28	6324	893.62	7.08	0.253	140	31.41	4.46	0.159	0.035	746	118.56	6.29	0.225	0.133	3574	538.88	6.63	0.237	0.603	1864	204.77	9.1	0.325	0.229
29	6333	873.99	7.25	0.25	94	21.73	4.33	0.149	0.025	619	100.15	6.18	0.213	0.115	3845	559.07	6.88	0.237	0.640	1775	193.04	9.19	0.317	0.221
30	6119	823.7	7.43	0.248	65	19.95	3.26	0.109	0.024	528	85.38	6.18	0.206	0.104	3803	541.64	7.02	0.234	0.658	1723	176.72	9.75	0.325	0.215
31	6161	808.7	7.62	0.246	60	8.96	6.69	0.216	0.011	487	74.22	6.56	0.212	0.092	4006	564.58	7.1	0.229	0.698	1608	160.93	9.99	0.322	0.199
32	6073	783.64	7.75	0.242	38	8.01	4.74	0.148	0.010	432	62.8	6.88	0.215	0.080	4131	562.56	7.34	0.229	0.718	1472	150.27	9.8	0.306	0.192
33	5996	747.95	8.02	0.243	22	5.54	3.97	0.12	0.007	353	51.51	6.85	0.208	0.069	4188	547.74	7.65	0.232	0.732	1433	143.17	10.01	0.303	0.191
34	5652	695	8.13	0.239	21	4.18	5.03	0.148	0.006	295	39.66	7.44	0.219	0.057	4034	523.63	7.7	0.227	0.753	1302	127.53	10.21	0.3	0.183
35	5470	648.7	8.43	0.241	14	1.95	7.17	0.205	0.003	260	37.41	6.95	0.199	0.058	3879	498.02	7.79	0.223	0.768	1317	111.32	11.83	0.338	0.172
36	5066	599.18	8.45	0.235	10	0.93	10.74	0.298	0.002	200	29.57	6.76	0.188	0.049	3747	466.11	8.04	0.223	0.778	1109	102.56	10.81	0.3	0.171

37	4788	557.43	8.59	0.232	5	0.6	8.34	0.225	0.001	189	25.55	7.4	0.2	0.046	3589	441.67	8.13	0.22	0.792	1005	89.61	11.22	0.303	0.161
38	4588	522.62	8.78	0.231	2	0.57	3.52	0.093	0.001	146	17.76	8.22	0.216	0.034	3538	415.42	8.52	0.224	0.795	902	88.87	10.15	0.267	0.170
39	4166	470.01	8.86	0.227	2	0.11	17.87	0.458	0.0002	116	15.52	7.47	0.192	0.033	3177	378.85	8.39	0.215	0.806	871	75.53	11.53	0.296	0.161
40	3710	413.97	8.96	0.224	2	0.09	23.23	0.581	0.0002	106	13.65	7.77	0.194	0.033	2881	333.49	8.64	0.216	0.806	721	66.75	10.8	0.27	0.161
41	3321	358.01	9.28	0.226						82	9.08	9.03	0.22	0.025	2556	290.57	8.8	0.215	0.812	683	58.36	11.7	0.285	0.163
42	3039	320.07	9.49	0.226						58	7.63	7.6	0.181	0.024	2310	260.01	8.88	0.212	0.812	671	52.43	12.8	0.305	0.164
43	2796	288.37	9.7	0.225						61	6.02	10.13	0.236	0.021	2124	237.36	8.95	0.208	0.823	611	44.99	13.58	0.316	0.156
44	2446	255.55	9.57	0.218						35	4.37	8.01	0.182	0.017	1896	210.47	9.01	0.205	0.824	515	40.71	12.65	0.287	0.159
45	2169	223.9	9.69	0.215						17	2.49	6.83	0.152	0.011	1705	186.48	9.14	0.203	0.833	447	34.93	12.8	0.284	0.156
46	1883	186.44	10.1	0.22						20	1.88	10.64	0.231	0.010	1529	157.28	9.72	0.211	0.844	334	27.28	12.24	0.266	0.146
47	1562	161.37	9.68	0.206						16	1.87	8.55	0.182	0.012	1241	135.51	9.16	0.195	0.840	305	23.99	12.72	0.271	0.149
48	1477	141.28	10.45	0.218						19	1.54	12.35	0.257	0.011	1159	116.82	9.92	0.207	0.827	299	22.92	13.05	0.272	0.162
49	1248	124.41	10.03	0.205						14	1.06	13.17	0.269	0.009	1007	101.85	9.89	0.202	0.819	227	21.5	10.56	0.216	0.173
50	1076	102.37	10.51	0.21						6	0.29	20.85	0.417	0.003	867	84.77	10.23	0.205	0.828	203	17.31	11.73	0.235	0.169
51	860	86.91	9.9	0.194						4	0.08	52.94	1.038	0.001	721	72.75	9.91	0.194	0.837	135	14.08	9.59	0.188	0.162
52	766	72.29	10.6	0.204						0	0.03	0	0	0.0004	629	62.24	10.11	0.194	0.861	137	10.02	13.67	0.263	0.139
53	629	55.73	11.29	0.213						0	0.13	0	0	0.002	500	47.64	10.5	0.198	0.855	129	7.96	16.21	0.306	0.143
54	518	45.14	11.48	0.213											397	37.57	10.57	0.196	0.832	121	7.57	15.99	0.296	0.168
55	406	35.94	11.3	0.205											326	28.1	11.6	0.211	0.782	80	7.84	10.2	0.185	0.218
56	302	28.59	10.56	0.189											240	22.54	10.65	0.19	0.788	62	6.04	10.26	0.183	0.211
57	258	23.65	10.91	0.191											182	18.22	9.99	0.175	0.770	76	5.44	13.98	0.245	0.230
58	171	14.75	11.6	0.2											134	12.12	11.06	0.191	0.822	37	2.63	14.08	0.243	0.178
59	125	10.22	12.23	0.207											107	8.83	12.11	0.205	0.864	18	1.39	12.98	0.22	0.136
60	101	6.65	15.18	0.253											78	5.93	13.15	0.219	0.892	23	0.72	31.83	0.531	0.108
61	71	4.96	14.33	0.235											57	4.63	12.32	0.202	0.933	14	0.33	42.71	0.7	0.067
62	41	4.48	9.14	0.147											39	4.41	8.84	0.143	0.984	2	0.07	27.07	0.437	0.016
63	35	2.9	12.06	0.191											34	2.64	12.9	0.205	0.910	1	0.27	3.76	0.06	0.093
64	29	1.78	16.31	0.255											27	1.59	17.03	0.266	0.893	2	0.19	10.4	0.163	0.107
65	10	0.57	17.52	0.27											8	0.41	19.63	0.302	0.719	2	0.16	12.24	0.188	0.281
66	7	0.79	8.89	0.135											4	0.59	6.83	0.104	0.747	3	0.2	14.84	0.225	0.253
67	4	0.56	7.17	0.107											4	0.56	7.17	0.107	1.0					
68	2	0.09	22.57	0.332											2	0.09	22.57	0.332	1.0					
69	1	0.07	15	0.217											1	0.07	15	0.217	1.0					
70	1	0.07	13.38	0.191											1	0.07	13.38	0.191	1.0					

Appendix 3: Time by ED state (sec.) variable

Appendix 3 consists of two main parts. The first part is an explanation of how to calculate the variable **Time by ED state**, while the second part is a guide to constructing this variable in SEESat.

The calculation of **Time by ED state** is illustrated by two types of examples. One is a simple calculation for a given dataset. The second type of examples helps one understand the calculation of the variable, given a more complex task, e.g. calculating **Time by ED state** for multiple ED units (Surgery + Internal, all ED without pediatrics and so on), or over multiple days. The last examples are only added to clarify the calculation of the variable, due to many questions that did arise on the subject.

The second part of this Appendix is rather technical and provides the steps to create the **Time by ED state** variable.

3.1 Definition of the variable

3.1.1 Simple calculation for a given dataset

3.1.1.1 Simple Example

First compute instants (moment of time) counts in time interval from start_time to end_time.

Define:

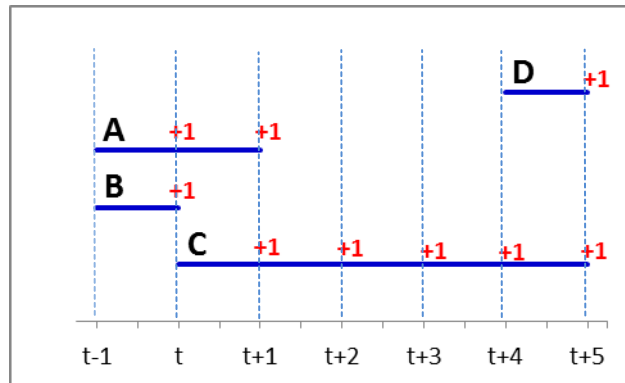
- **Discrete scale of time:** 24 hours of day divided into 86400 one second length time intervals.
- m_j – moment of time j , or second $_j$; $j=1, 2, \dots, nt$;
 nt – length of time interval or number of moments of time;

$$nt = end_time - start_time + 1$$

- x_i – event i (for example call waited in queue or patient gets treatment in ED);
 $i=1, 2, \dots, n$;
 n – total number of events
- x_{iopen} – “open” event i at moment of time, so that event start $>$ start_time and event end $\leq$ end_time
- $N_{at\ moment\ i}$ – number of “open” events at moment of time i
$$N_{at\ moment\ i} = \sum_i^n x_{iopen}$$

Events A, B, C, D were observed at time interval from $t-1$ to $t+5$. Event start time and event end time known.

event	event start	event end
A	$t-1$	$t+1$
B	$t-1$	t
C	t	$t+5$
D	$t+4$	$t+5$



+1 – add “open” event at moment of time

Questions: How many “open” events were at every moment of time in defined interval?

Let’s see the sample:

$n = 4$

start_time = $t-1$

end_time = $t+5$

$nt = t+5 - (t-1) + 1 = 7$ moments of time

j	m_j	$N_{\text{at moment } i}$	X_{iopen}
1	$t-1$	0	
2	t	2	A, B
3	$t+1$	2	A, C
4	$t+2$	1	C
5	$t+3$	1	C
6	$t+4$	1	C
7	$t+5$	2	C, D

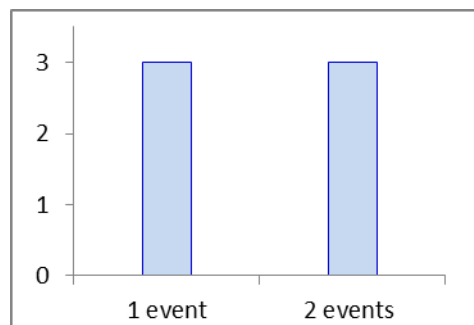
The creation of $N_{\text{at moment } i}$ via SEESat can be found in [Part 3.2.1](#) of this appendix.

Second step of variable definition is to compute frequencies of X_{iopen}

$N_{\text{at moment } i}$	Frequencies	Moment of time
1	3	$t+2, t+3, t+4$
2	3	$t, t+1, t+5$

One event was during 3 seconds in time interval from $t-1$ to $t+5$.

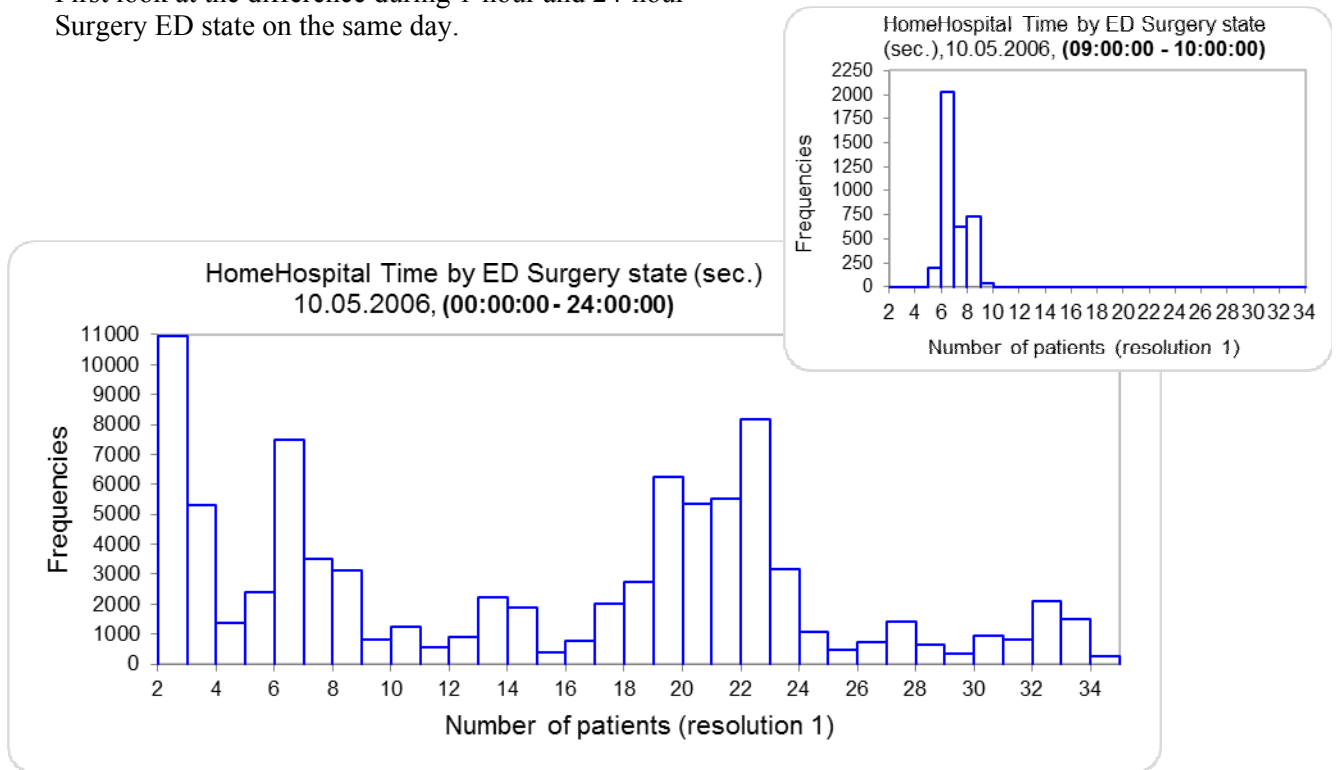
Two events were during 3 seconds in time interval from $t-1$ to $t+5$



The creation of frequencies of $N_{\text{at moment } i}$ via SEESat can be found in [Part 3.2.2](#) of this appendix.

3.1.1.2 Numerical Example: Surgery ED state

First look at the difference during 1-hour and 24-hour Surgery ED state on the same day.



Time by ED Surgery state (sec.), 10.05.2006, (00:00:00 – 24:00:00)				
Number of patients	Frequency	Relative frequency %	Cumulative frequency	Relative Cumulative frequency %
2	10964	12.69	10964	12.69
3	5293	6.13	16257	18.82
4	1384	1.60	17641	20.42
5	2406	2.78	20047	23.20
6	7475	8.65	27522	31.85
7	3493	4.04	31015	35.90
8	3111	3.60	34126	39.50
9	819	0.95	34945	40.45
10	1262	1.46	36207	41.91
11	562	0.65	36769	42.56
12	895	1.04	37664	43.59
13	2249	2.60	39913	46.20
14	1877	2.17	41790	48.37
15	396	0.46	42186	48.83
16	753	0.87	42939	49.70
17	2035	2.36	44974	52.05
18	2725	3.15	47699	55.21
19	6233	7.21	53932	62.42
20	5348	6.19	59280	68.61
21	5519	6.39	64799	75.00
22	8185	9.47	72984	84.47
23	3173	3.67	76157	88.14
24	1073	1.24	77230	89.39
25	457	0.53	77687	89.92
26	716	0.83	78403	90.74

27	1412	1.63	79815	92.38
28	628	0.73	80443	93.11
29	337	0.39	80780	93.50
30	961	1.11	81741	94.61
31	803	0.93	82544	95.54
32	2091	2.42	84635	97.96
33	1486	1.72	86121	99.68
34	279	0.32	86400	100.00

Time by ED Surgery state (sec.), 10.05.2006, (09:00:00 – 10:00:00)				
Number of patients	Frequency	Relative frequency%	Cumulative frequency	Relative Cumulative frequency %
5	191	5	191	5
6	2022	56	2213	61
7	619	17	2832	79
8	729	20	3561	99
9	39	1	3600	100

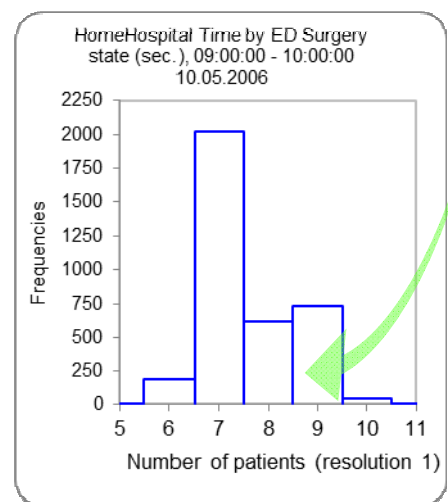
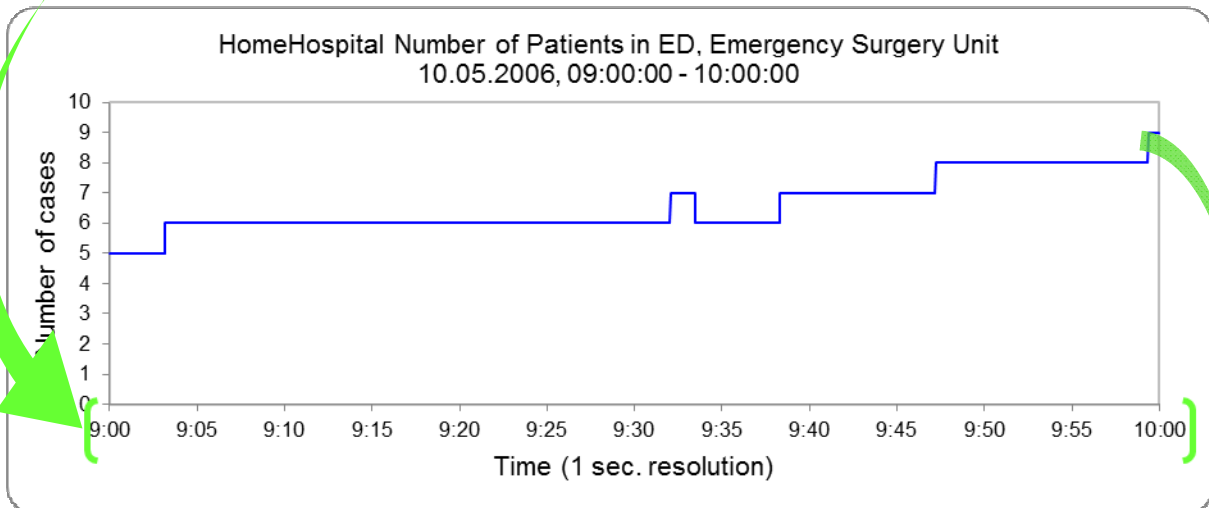
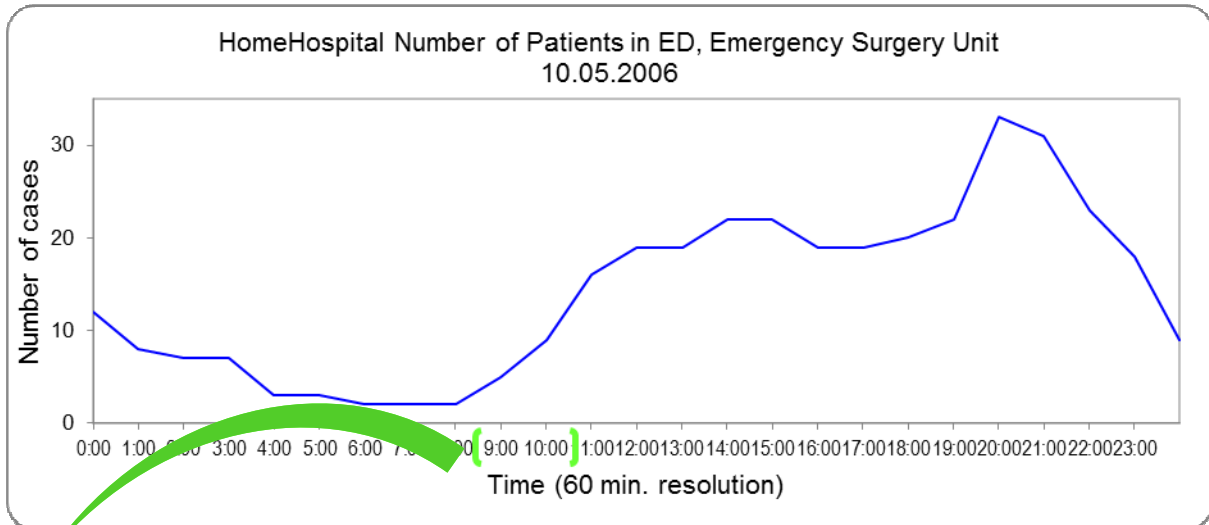
Time by ED Surgery state (sec.), 10.05.2006, (00:00:00 – 24:00:00) Statistics	
	Time by ED Surgery state (sec.)
N	86400
Mean	14.33
Standard Deviation	9.21
Variance	84.81
Median	17
Minimum	2
Maximum	34

Time by ED Surgery state (sec.), 10.05.2006, (09:00:00 – 10:00:00) Statistics	
	Time by ED Surgery state (sec.)
N	3600
Mean	6.556
Standard Deviation	0.907
Variance	0.823
Median	6
Minimum	5
Maximum	9

Data	
Time	Number of Patients in Surgery ED
09:00:00	5
09:00:01	5
09:00:02	5
09:00:03	5
09:00:04	5
09:00:05	5
09:00:06	5
09:00:07	5
09:00:08	5
09:00:09	5
...	...
10:00:00	9

N = 3600

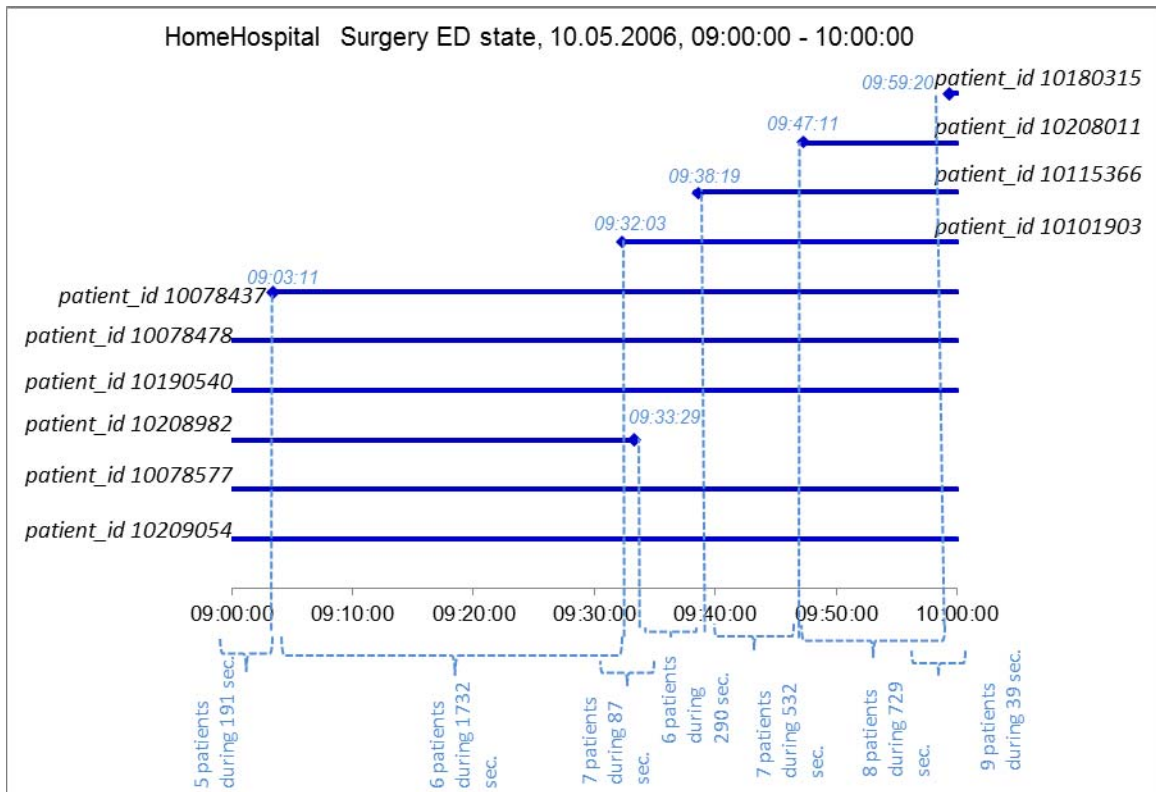
Calculation of ED state during 1 hour from 09:00 to 10:00 a.m..



Data sample: SELECT visit_details.* INTO data_sample FROM visit_details WHERE (entry_group=1 AND department=2 AND entry_date < #5/10/2006 10:00:00# AND exit_date > #5/10/2006 09:00:00#);

#	patient id	medical id	gender	department	entry date	exit date	outcome	age years	age months
1	10209054	20381564	1	2	09/May/2006 15:10:28	11/May/2006 10:17:44	7	30	3
2	10078577	20134193	2	2	09/May/2006 15:33:11	10/May/2006 10:32:50	2	85	4
3	10208982	20381437	1	2	10/May/2006 08:21:58	10/May/2006 09:33:29	7	18	11
4	10190540	20347728	1	2	10/May/2006 08:24:24	10/May/2006 10:41:12	7	52	8
5	10078478	20133991	2	2	10/May/2006 08:26:55	10/May/2006 14:28:35	7	79	4
6	10078437	20133908	2	2	10/May/2006 09:03:10	10/May/2006 12:58:18	7	24	7
7	10101903	20178962	2	2	10/May/2006 09:32:02	10/May/2006 13:21:32	2	68	5
8	10115366	20382950	1	2	10/May/2006 09:38:19	10/May/2006 14:19:28	2	29	10
9	10208011	20381293	1	2	10/May/2006 09:47:11	10/May/2006 10:35:02	7	43	4
10	10180315	20381438	1	2	10/May/2006 09:59:20	10/May/2006 13:26:00	7	49	10

Surgery ED state, 10.05.2006, 09:00:00 – 10:00:00			
Time	number of patients	patient id	duration (seconds)
[09:00:00 – 09:03:10]	5	10209054, 10078577, 10208982, 10190540, 10078478	191
[09:03:10 – 09:32:02]	6	10209054, 10078577, 10208982, 10190540, 10078478, 10078437	1732
[09:32:02 – 09:33:29]	7	10209054, 10078577, 10208982, 10190540, 10078478, 10078437, 10101903	87
[09:33:29 – 09:38:19]	6	10209054, 10078577, 10190540, 10078478, 10078437, 10101903	290
[09:38:19 – 09:47:11]	7	10209054, 10078577, 10190540, 10078478, 10078437, 10101903, 10115366	532
[09:47:11 – 09:59:20]	8	10209054, 10078577, 10190540, 10078478, 10078437, 10101903, 10115366, 10208011	729
[09:59:20 – 10:00:00]	9	10209054, 10078577, 10190540, 10078478, 10078437, 10101903, 10115366, 10208011, 10180315	39

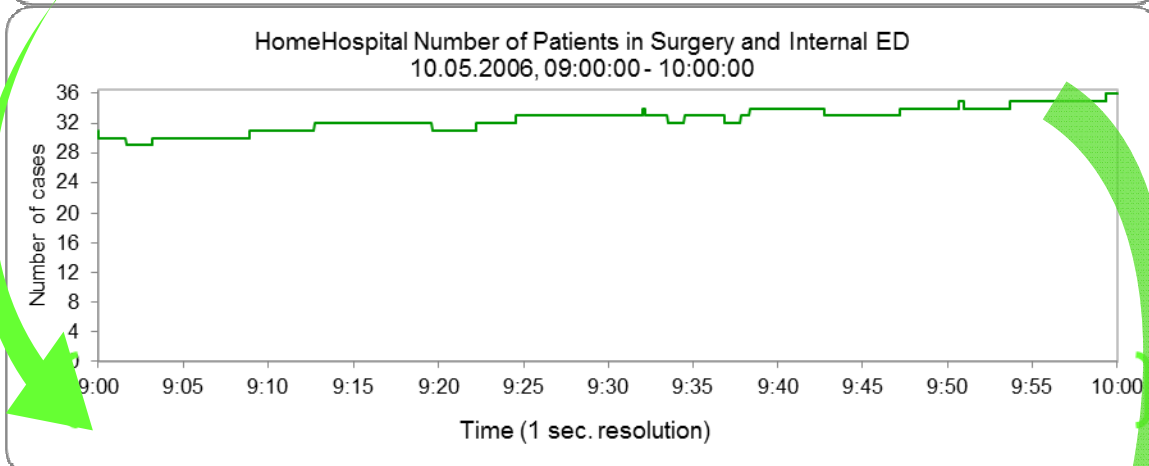
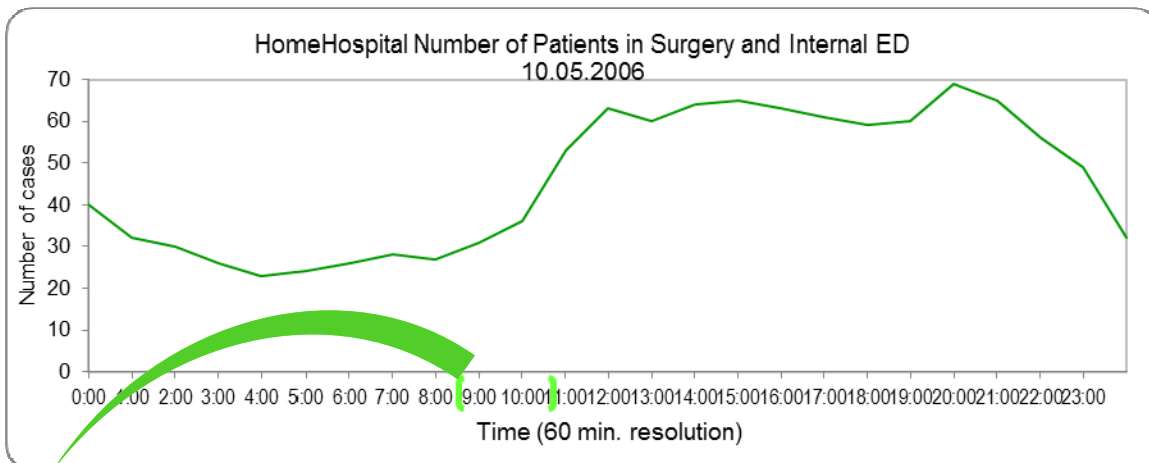


3.1.1.3 Numerical Example: Surgery and Internal ED state

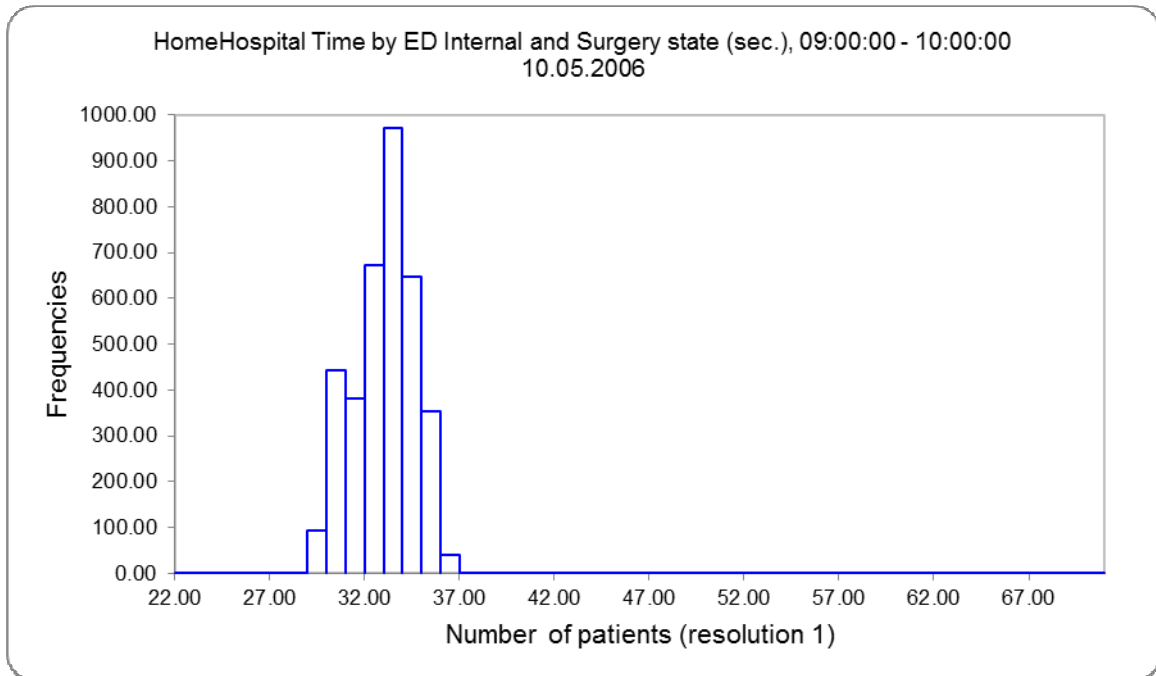
Data sample: `SELECT visit_details.* INTO data_sample FROM visit_details WHERE (entry_group=1 AND (department=1 or department=2) AND entry_date < #5/10/2006 10:00:00# AND exit_date > #5/10/2006 09:00:00#);`



#	patient id	medical id	gender	department	entry date	exit date	outcome	age years	age months
1	10050255	20087589	2	1	03/May/2006 22:44:20	12/May/2006 02:29:20	7	26	4
2	10209054	20381564	1	2	09/May/2006 15:10:28	11/May/2006 10:17:44	7	30	3
3	10078577	20134193	2	2	09/May/2006 15:33:11	10/May/2006 10:32:50	2	85	4
4	10032429	20114928	2	1	09/May/2006 18:05:26	10/May/2006 09:19:35	2	49	7
5	10116529	20220470	1	1	09/May/2006 20:10:58	10/May/2006 12:18:29	2	44	11
6	10173335	20316317	1	1	09/May/2006 20:14:53	10/May/2006 10:46:03	7	23	3
7	10055663	20087584	2	1	09/May/2006 21:54:19	10/May/2006 14:57:20	7	22	9
8	10046576	20114954	2	1	09/May/2006 21:58:28	10/May/2006 10:56:20	7	30	7
9	10160307	20318805	1	1	09/May/2006 22:10:34	10/May/2006 10:46:22	7	63	11
10	10000958	20114958	2	1	09/May/2006 22:39:55	10/May/2006 09:50:57	2	53	10
11	10043359	20064973	2	1	09/May/2006 23:15:10	10/May/2006 09:42:43	7	82	2
12	10144618	20329950	1	1	10/May/2006 00:12:55	10/May/2006 12:36:23	2	18	9
13	10027827	20087632	2	1	10/May/2006 03:52:34	10/May/2006 11:09:06	7	34	6
14	10053221	20114968	2	1	10/May/2006 05:02:07	10/May/2006 14:52:14	2	55	0
15	10132704	20295135	1	1	10/May/2006 05:05:19	10/May/2006 09:32:09	7	49	0
16	10020926	20028380	2	1	10/May/2006 05:08:29	10/May/2006 12:08:38	2	63	10
17	10180555	20329953	1	1	10/May/2006 05:32:05	10/May/2006 09:01:37	2	40	3
18	10145499	20295136	1	1	10/May/2006 05:33:09	10/May/2006 09:36:50	7	69	0
19	10164127	20295137	1	1	10/May/2006 05:55:45	10/May/2006 13:40:59	7	22	1
20	10117576	20329954	1	1	10/May/2006 06:15:26	10/May/2006 14:27:05	2	53	0
21	10116665	20329957	1	1	10/May/2006 06:58:57	10/May/2006 16:26:17	2	84	7
22	10034971	20070183	2	1	10/May/2006 07:05:55	10/May/2006 23:50:00	8	59	5
23	10164030	20294954	1	1	10/May/2006 07:57:08	10/May/2006 10:00:44	7	17	0
24	10208982	20381437	1	2	10/May/2006 08:21:58	10/May/2006 09:33:29	7	18	11
25	10190540	20347728	1	2	10/May/2006 08:24:24	10/May/2006 10:41:12	7	52	8
26	10055664	20087586	2	1	10/May/2006 08:24:26	10/May/2006 10:58:42	7	67	8
27	10078478	20133991	2	2	10/May/2006 08:26:55	10/May/2006 14:28:35	7	79	4
28	10116112	20295082	1	1	10/May/2006 08:27:23	10/May/2006 15:11:07	7	64	7
29	10116596	20295138	1	1	10/May/2006 08:33:46	10/May/2006 12:16:42	7	58	4
30	10055630	20087511	2	1	10/May/2006 08:56:18	10/May/2006 14:41:29	7	58	8
31	10078437	20133908	2	2	10/May/2006 09:03:10	10/May/2006 12:58:18	7	24	7
32	10012605	20017254	2	1	10/May/2006 09:08:55	10/May/2006 13:43:59	7	55	10
33	10164086	20295065	1	1	10/May/2006 09:12:39	10/May/2006 11:15:28	7	74	9
34	10116386	20220495	1	1	10/May/2006 09:22:12	10/May/2006 16:16:51	2	73	6
35	10115313	20316325	1	1	10/May/2006 09:24:33	10/May/2006 15:21:25	2	61	0
36	10101903	20178962	2	2	10/May/2006 09:32:02	10/May/2006 13:21:32	2	68	5
37	10118058	20222601	1	1	10/May/2006 09:34:28	10/May/2006 12:56:36	7	77	4
38	10060967	20101007	2	1	10/May/2006 09:37:47	10/May/2006 10:35:59	2	67	8
39	10115366	20382950	1	2	10/May/2006 09:38:19	10/May/2006 14:19:28	2	29	10
40	10208011	20381293	1	2	10/May/2006 09:47:11	10/May/2006 10:35:02	7	43	4
41	10114066	20222624	1	1	10/May/2006 09:50:41	10/May/2006 11:33:37	7	76	4
42	10055656	20087559	2	1	10/May/2006 09:53:42	10/May/2006 17:50:35	7	45	10
43	10180315	20381438	1	2	10/May/2006 09:59:20	10/May/2006 13:26:00	7	49	10



Surgery and Internal ED state, 10.05.2006, 09:00:00 – 10:00:00		
Time	number of patients	duration (seconds)
[09:00:00 – 09:00:01)	31	1
[09:00:01 – 09:01:37)	30	97
[09:01:37 – 09:03:10)	29	93
[09:03:10 – 09:08:55)	30	345
[09:08:55 – 09:12:39)	31	224
[09:12:39 – 09:19:35)	32	416
[09:19:35 – 09:22:12)	31	157
[09:22:12 – 09:24:33)	32	141
[09:24:33 – 09:32:02)	33	449
[09:32:02 – 09:32:09)	34	7
[09:32:09 – 09:33:29)	33	80
[09:33:29 – 09:34:28)	32	59
[09:34:28 – 09:36:50)	33	142
[09:36:50 – 09:37:47)	32	57
[09:37:47 – 09:38:19)	33	32
[09:38:19 – 09:42:43)	34	264
[09:42:43 – 09:47:11)	33	268
[09:47:11 – 09:50:41)	34	210
[09:50:41 – 09:50:57)	35	16
[09:50:57 – 09:53:42)	34	165
[09:53:42 – 09:59:20)	35	338
[09:59:20 – 10:00:00)	36	39



HomeHospital Time by ED Internal and Surgery state (sec.), 10.05.2006, 09:00:00 – 10:00:00				
Number of patients	Frequency	Relative frequency %	Cumulative frequency	Relative Cumulative frequency %
29	93	2.58	93	2.58
30	442	12.28	535	14.86
31	382	10.61	917	25.47
32	673	18.69	1590	44.17
33	971	26.97	2561	71.14
34	646	17.94	3207	89.08
35	354	9.83	3561	98.92
36	39	1.08	3600	100.00

For example: 35 patients were in Internal and Surgery ED during 354 seconds in time interval from 09:00 to 10:00.

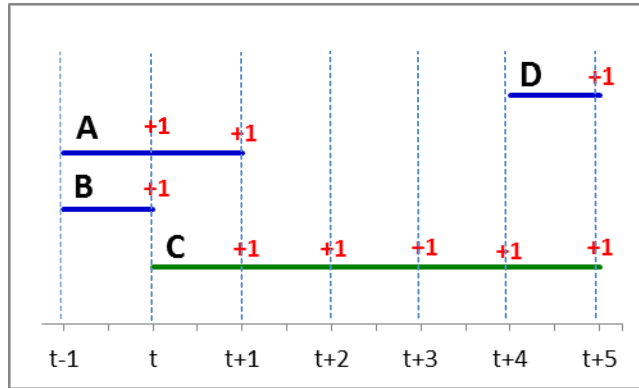
3.1.2 Calculation for multiple units or one unit over multiple days

3.1.2.1 Simple Example (2 units at same time interval)

Calculate the number of events at moment of time as a sum of the different types of events:

Events A, B, C, D were observed at time interval from $t-1$ to $t+5$. Event start time and event end time known. Define events A, B, D belonging to type I and event C belonging to type II.

event		event start	event end
type I	type II		
A		$t-1$	$t+1$
B		$t-1$	t
D		$t+4$	$t+5$
	C	t	$t+5$

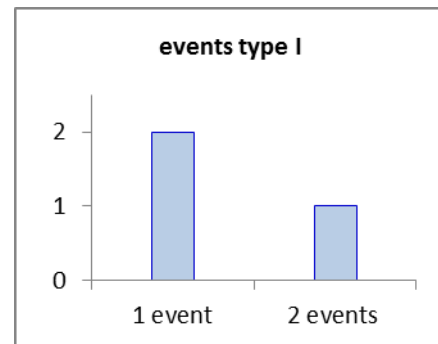


+1 – add “open” event at moment of time

Questions: How many “open” events were at every moment of time in the defined interval by event type I and type II?

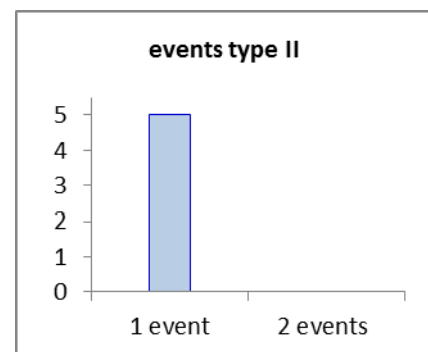
type I			
j	m_j	N_{at} moment i	x_{iopen}
1	$t-1$	0	
2	t	2	A, B
3	$t+1$	1	A
4	$t+2$	0	
5	$t+3$	0	
6	$t+4$	0	
7	$t+5$	1	D

type I		
N_{at} moment i	Frequencies	Moment of time
1	2	$t+1, t+5$
2	1	t



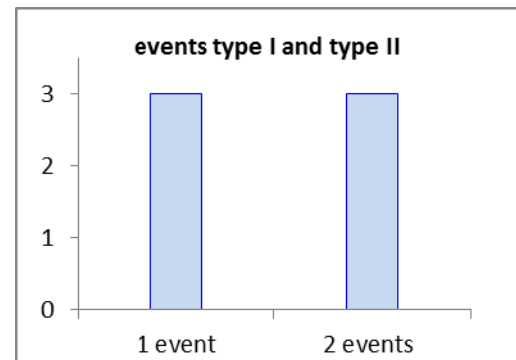
type II			
j	m_j	N_{at} moment i	x_{iopen}
1	$t-1$	0	
2	t	0	
3	$t+1$	1	C
4	$t+2$	1	C
5	$t+3$	1	C
6	$t+4$	1	C
7	$t+5$	1	C

type II		
N_{at} moment i	Frequencies	Moment of time
1	5	$t+1, t+2, t+3, t+4, t+5$

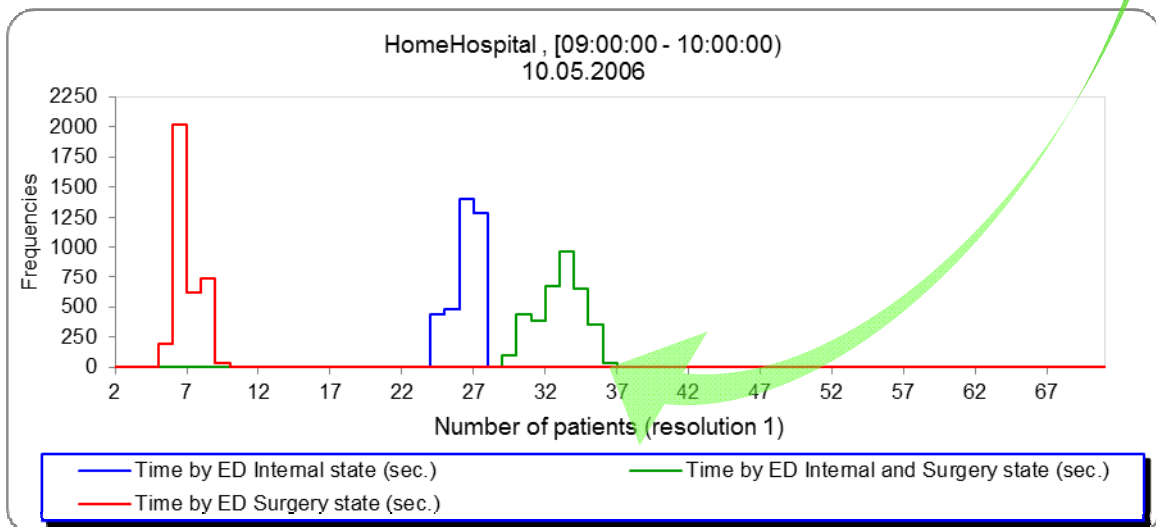
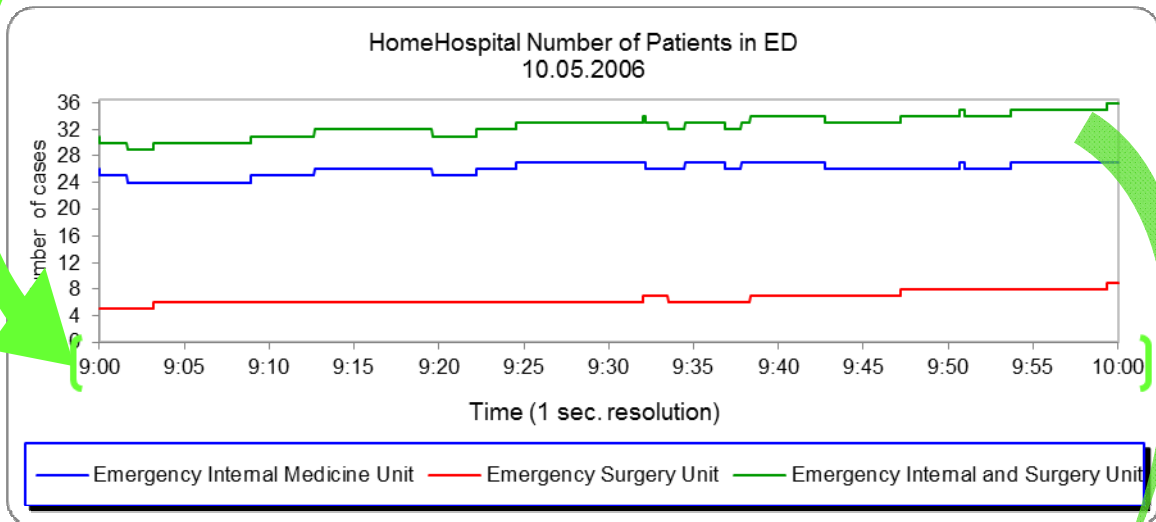
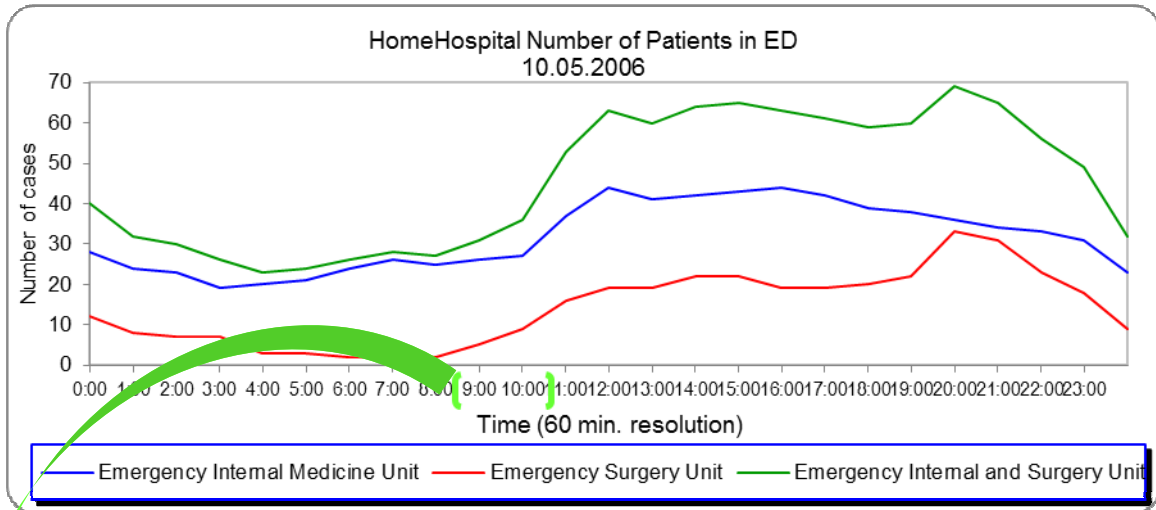


If we want to find the $N_{at \text{ moment } i}$ for type I and type II together. We cannot summarize frequencies of type I and type II, but we can summarize $N_{at \text{ moment } i}$ at every moment of time.

		N _{at} moment i		X _{iopen}		N _{at} moment i	X _{iopen}
j	m _j	type I	type II	type I	type II	type I and type II	
1	t-1	0	0			0	
2	t	2	0	A, B		2	A, B
3	t+1	1	1	A	C	2	A, C
4	t+2	0	1		C	1	C
5	t+3	0	1		C	1	C
6	t+4	0	1		C	1	C
7	t+5	1	1	D	C	2	D, C



3.1.2.2 Numerical example: Surgery and Internal ED state (2 units over 1 day at same time)



Data sample: SELECT visit_details.* INTO data_sample FROM visit_details WHERE (entry_group=1 AND department=1 AND entry_date < #5/10/2006 10:00:00# AND exit_date > #5/10/2006 09:00:00#);

#	patient id	medical id	gender	department	entry date	exit date	outcome	age years	age months
1	10050255	20087589	2	1	03/May/2006 22:44:20	12/May/2006 02:29:20	7	26	4
2	10032429	20114928	2	1	09/May/2006 18:05:26	10/May/2006 09:19:35	2	49	7
3	10116529	20220470	1	1	09/May/2006 20:10:58	10/May/2006 12:18:29	2	44	11
4	10173335	20316317	1	1	09/May/2006 20:14:53	10/May/2006 10:46:03	7	23	3
5	10055663	20087584	2	1	09/May/2006 21:54:19	10/May/2006 14:57:20	7	22	9
6	10046576	20114954	2	1	09/May/2006 21:58:28	10/May/2006 10:56:20	7	30	7
7	10160307	20318805	1	1	09/May/2006 22:10:34	10/May/2006 10:46:22	7	63	11
8	10000958	20114958	2	1	09/May/2006 22:39:55	10/May/2006 09:50:57	2	53	10
9	10043359	20064973	2	1	09/May/2006 23:15:10	10/May/2006 09:42:43	7	82	2
10	10144618	20329950	1	1	10/May/2006 00:12:55	10/May/2006 12:36:23	2	18	9
11	10027827	20087632	2	1	10/May/2006 03:52:34	10/May/2006 11:09:06	7	34	6
12	10053221	20114968	2	1	10/May/2006 05:02:07	10/May/2006 14:52:14	2	55	0
13	10132704	20295135	1	1	10/May/2006 05:05:19	10/May/2006 09:32:09	7	49	0
14	10020926	20028380	2	1	10/May/2006 05:08:29	10/May/2006 12:08:38	2	63	10
15	10180555	20329953	1	1	10/May/2006 05:32:05	10/May/2006 09:01:37	2	40	3
16	10145499	20295136	1	1	10/May/2006 05:33:09	10/May/2006 09:36:50	7	69	0
17	10164127	20295137	1	1	10/May/2006 05:55:45	10/May/2006 13:40:59	7	22	1
18	10117576	20329954	1	1	10/May/2006 06:15:26	10/May/2006 14:27:05	2	53	0
19	10116665	20329957	1	1	10/May/2006 06:58:57	10/May/2006 16:26:17	2	84	7
20	10034971	20070183	2	1	10/May/2006 07:05:55	10/May/2006 23:50:00	8	59	5
21	10164030	20294954	1	1	10/May/2006 07:57:08	10/May/2006 10:00:44	7	17	0
22	10055664	20087586	2	1	10/May/2006 08:24:26	10/May/2006 10:58:42	7	67	8
23	10116112	20295082	1	1	10/May/2006 08:27:23	10/May/2006 15:11:07	7	64	7
24	10116596	20295138	1	1	10/May/2006 08:33:46	10/May/2006 12:16:42	7	58	4
25	10055630	20087511	2	1	10/May/2006 08:56:18	10/May/2006 14:41:29	7	58	8
26	10012605	20017254	2	1	10/May/2006 09:08:55	10/May/2006 13:43:59	7	55	10
27	10164086	20295065	1	1	10/May/2006 09:12:39	10/May/2006 11:15:28	7	74	9
28	10116386	20220495	1	1	10/May/2006 09:22:12	10/May/2006 16:16:51	2	73	6
29	10115313	20316325	1	1	10/May/2006 09:24:33	10/May/2006 15:21:25	2	61	0
30	10118058	20222601	1	1	10/May/2006 09:34:28	10/May/2006 12:56:36	7	77	4
31	10060967	20101007	2	1	10/May/2006 09:37:47	10/May/2006 10:35:59	2	67	8
32	10114066	20222624	1	1	10/May/2006 09:50:41	10/May/2006 11:33:37	7	76	4
33	10055656	20087559	2	1	10/May/2006 09:53:42	10/May/2006 17:50:35	7	45	10

Data sample: SELECT visit_details.* INTO data_sample FROM visit_details WHERE (entry_group=1 AND department=2 AND entry_date < #5/10/2006 10:00:00# AND exit_date > #5/10/2006 09:00:00#);

#	patient id	medical id	gender	department	entry date	exit date	outcome	age years	age months
1	10209054	20381564	1	2	09/May/2006 15:10:28	11/May/2006 10:17:44	7	30	3
2	10078577	20134193	2	2	09/May/2006 15:33:11	10/May/2006 10:32:50	2	85	4
3	10208982	20381437	1	2	10/May/2006 08:21:58	10/May/2006 09:33:29	7	18	11
4	10190540	20347728	1	2	10/May/2006 08:24:24	10/May/2006 10:41:12	7	52	8
5	10078478	20133991	2	2	10/May/2006 08:26:55	10/May/2006 14:28:35	7	79	4
6	10078437	20133908	2	2	10/May/2006 09:03:10	10/May/2006 12:58:18	7	24	7
7	10101903	20178962	2	2	10/May/2006 09:32:02	10/May/2006 13:21:32	2	68	5
8	10115366	20382950	1	2	10/May/2006 09:38:19	10/May/2006 14:19:28	2	29	10
9	10208011	20381293	1	2	10/May/2006 09:47:11	10/May/2006 10:35:02	7	43	4
10	10180315	20381438	1	2	10/May/2006 09:59:20	10/May/2006 13:26:00	7	49	10

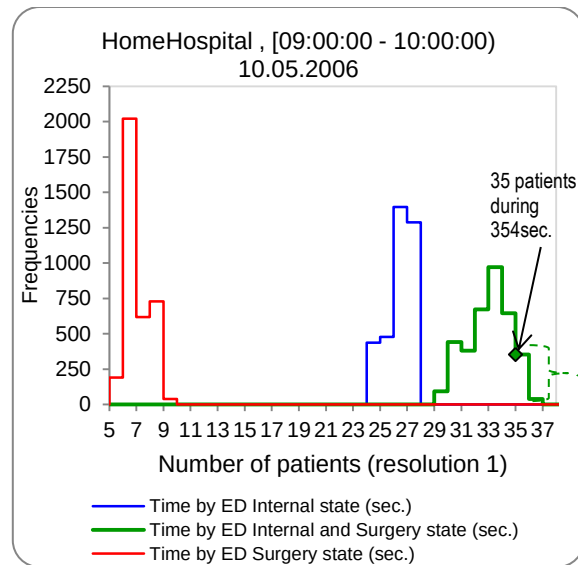
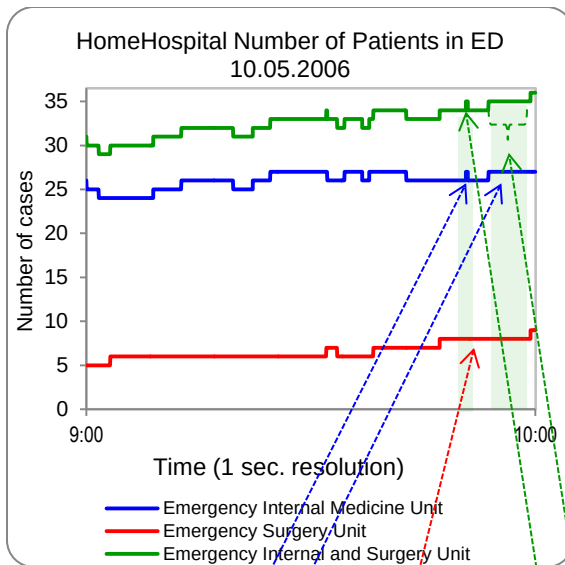
Internal ED state			Surgery ED state			Internal and Surgery ED state		
Time	number of patients	duration (seconds)	Time	number of patients	duration (seconds)	Time	number of patients	duration (seconds)
[09:00:00 – 09:00:01]	26	1	[09:00:00 – 09:03:10]	5	191	[09:00:00 – 09:00:01]	31	1
[09:00:01 – 09:01:37]	25	97	[09:03:10 – 09:32:02]	6	1732	[09:00:01 – 09:01:37]	30	97
[09:01:37 – 09:08:55]	24	438	[09:32:02 – 09:33:29]	7	87	[09:01:37 – 09:03:10]	29	93
[09:08:55 – 09:12:39]	25	224	[09:33:29 – 09:38:19]	6	290	[09:03:10 – 09:08:55]	30	345
[09:12:39 – 09:19:35]	26	416	[09:38:19 – 09:47:11]	7	532	[09:08:55 – 09:12:39]	31	224
[09:19:35 – 09:22:12]	25	157	[09:47:11 – 09:59:20]	8	729	[09:12:39 – 09:19:35]	32	416
[09:22:12 – 09:24:33]	26	141	[09:59:20 – 10:00:00]	9	39	[09:19:35 – 09:22:12]	31	157
[09:24:33 – 09:32:09]	27	456				[09:22:12 – 09:24:33]	32	141
[09:32:09 – 09:34:28]	26	139				[09:24:33 – 09:32:02]	33	449
[09:34:28 – 09:36:50]	27	142				[09:32:02 – 09:32:09]	34	7
[09:36:50 – 09:37:47]	26	57				[09:32:09 – 09:33:29]	33	80
[09:37:47 – 09:42:43]	27	296				[09:33:29 – 09:34:28]	32	59
[09:42:43 – 09:50:41]	26	478				[09:34:28 – 09:36:50]	33	142
[09:50:41 – 09:50:57]	27	16				[09:36:50 – 09:37:47]	32	57
[09:50:57 – 09:53:42]	26	165				[09:37:47 – 09:38:19]	33	32
[09:53:42 – 10:00:00]	27	377				[09:38:19 – 09:42:43]	34	264
						[09:42:43 – 09:47:11]	33	268
						[09:47:11 – 09:50:41]	34	210
						[09:50:41 – 09:50:57]	35	16
						[09:50:57 – 09:53:42]	34	165
						[09:53:42 – 09:59:20]	35	338
						[09:59:20 – 10:00:00]	36	39

Number of patients	Frequency		
	Time by ED Internal state (sec.)	Time by ED Internal and Surgery state (sec.)	Time by ED Surgery state (sec.)
5	0	0	191
6	0	0	2022
7	0	0	619
8	0	0	729
9	0	0	39
10	0	0	0
11	0	0	0
12	0	0	0
13	0	0	0
14	0	0	0
15	0	0	0
16	0	0	0
17	0	0	0
18	0	0	0
19	0	0	0
20	0	0	0
21	0	0	0
22	0	0	0
23	0	0	0
24	438	0	0
25	478	0	0
26	1397	0	0
27	1287	0	0
28	0	0	0
29	0	93	0

30	0	442	0
31	0	382	0
32	0	673	0
33	0	971	0
34	0	646	0
35	0	354	0
36	0	39	0

If we want to obtain $N_{\text{at moment } i}$ for both Surgery ED and Internal ED, we can summarize $N_{\text{at moment } i}$ for every moment in time or, if we want to summarize in some interval of time we may only do so until the first “jump” in $N_{\text{at moment } i}$ (either for Surgery or for Internal). See the following table.

Internal ED state			Surgery ED state			Internal and Surgery ED state		
Time	number of patients	duration (seconds)	Time	number of patients	duration (seconds)	Time	number of patients	duration (seconds)
[09:00:00 – 09:00:01]	26	1	[09:00:00 – 09:00:01]	5	1	[09:00:00 – 09:00:01]	31	1
[09:00:01 – 09:01:37]	25	97	[09:00:01 – 09:01:37]	5	97	[09:00:01 – 09:01:37]	30	97
[09:01:37 – 09:03:10]	24	93	[09:01:37 – 09:03:10]	5	93	[09:01:37 – 09:03:10]	29	93
[09:03:10 – 09:08:55]	24	345	[09:03:10 – 09:08:55]	6	345	[09:03:10 – 09:08:55]	30	345
[09:08:55 – 09:12:39]	25	224	[09:08:55 – 09:12:39]	6	224	[09:08:55 – 09:12:39]	31	224
[09:12:39 – 09:19:35]	26	416	[09:12:39 – 09:19:35]	6	416	[09:12:39 – 09:19:35]	32	416
[09:19:35 – 09:22:12]	25	157	[09:19:35 – 09:22:12]	6	157	[09:19:35 – 09:22:12]	31	157
[09:22:12 – 09:24:33]	26	141	[09:22:12 – 09:24:33]	6	141	[09:22:12 – 09:24:33]	32	141
[09:24:33 – 09:32:02]	27	449	[09:24:33 – 09:32:02]	6	449	[09:24:33 – 09:32:02]	33	449
[09:32:02 – 09:32:09]	27	7	[09:32:02 – 09:32:09]	7	7	[09:32:02 – 09:32:09]	34	7
[09:32:09 – 09:33:29]	26	80	[09:32:09 – 09:33:29]	7	80	[09:32:09 – 09:33:29]	33	80
[09:33:29 – 09:34:28]	26	59	[09:33:29 – 09:34:28]	6	59	[09:33:29 – 09:34:28]	32	59
[09:34:28 – 09:36:50]	27	142	[09:34:28 – 09:36:50]	6	142	[09:34:28 – 09:36:50]	33	142
[09:36:50 – 09:37:47]	26	57	[09:36:50 – 09:37:47]	6	57	[09:36:50 – 09:37:47]	32	57
[09:37:47 – 09:38:19]	27	32	[09:37:47 – 09:38:19]	6	32	[09:37:47 – 09:38:19]	33	32
[09:38:19 – 09:42:43]	27	264	[09:38:19 – 09:42:43]	7	264	[09:38:19 – 09:42:43]	34	264
[09:42:43 – 09:47:11]	26	268	[09:42:43 – 09:47:11]	7	268	[09:42:43 – 09:47:11]	33	268
[09:47:11 – 09:50:41]	26	210	[09:47:11 – 09:50:41]	8	210	[09:47:11 – 09:50:41]	34	210
[09:50:41 – 09:50:57]	27	16	[09:50:41 – 09:50:57]	8	16	[09:50:41 – 09:50:57]	35	16
[09:50:57 – 09:53:42]	26	165	[09:50:57 – 09:53:42]	8	165	[09:50:57 – 09:53:42]	34	165
[09:53:42 – 09:59:20]	27	338	[09:53:42 – 09:59:20]	8	338	[09:53:42 – 09:59:20]	35	338
[09:59:20 – 10:00:00]	27	39	[09:59:20 – 10:00:00]	9	39	[09:59:20 – 10:00:00]	36	39



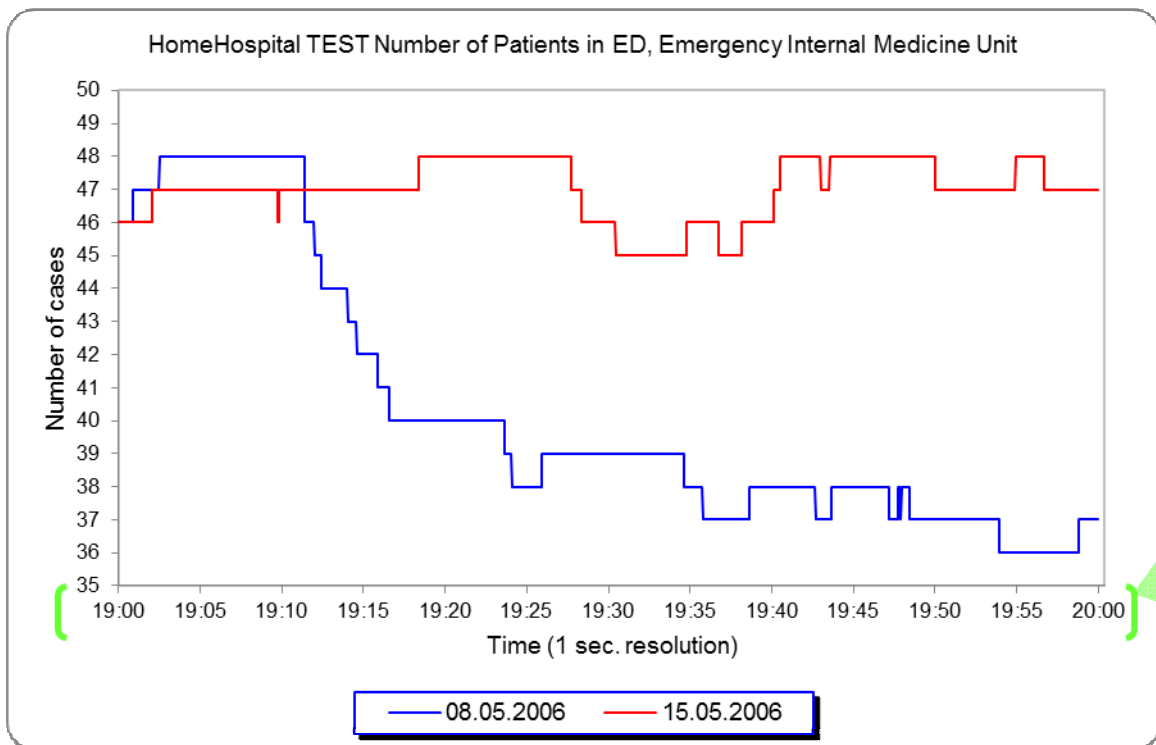
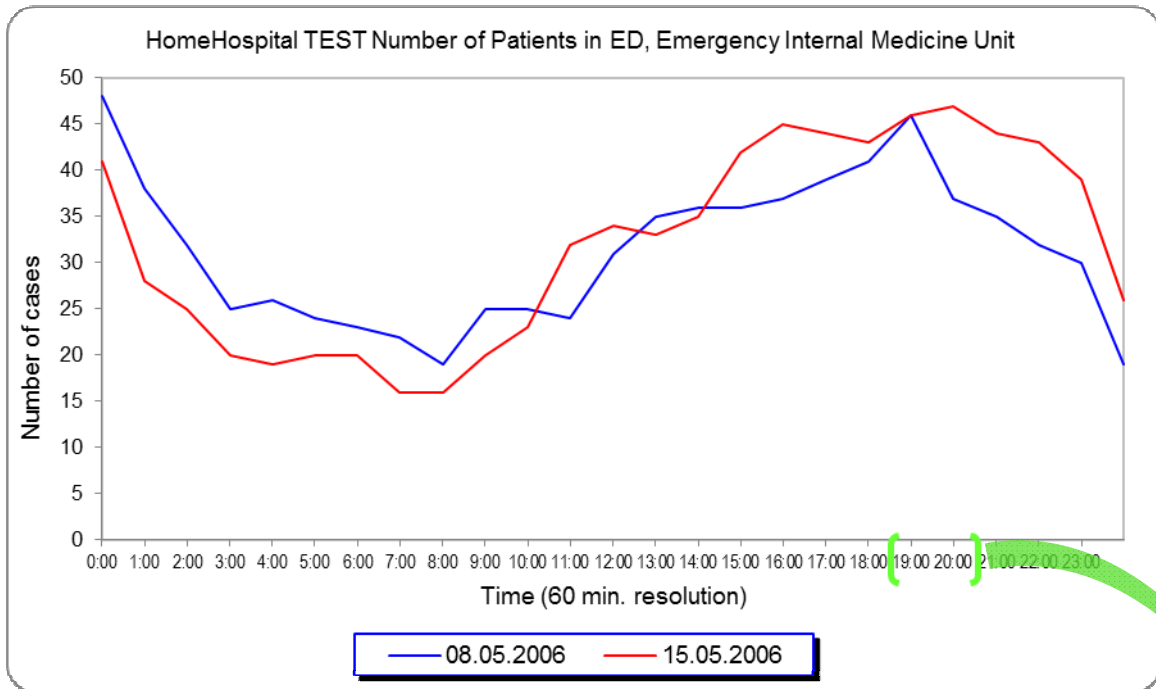
27 patients in Internal ED in
[09:50:41 - 09:50:57) and
[09:53:42 - 09:59:20)



8 patients in Surgery ED in
[09:50:41 - 09:59:20)

35 patients in Internal and Surgery ED,
during 354 sec:
16 sec [09:50:41 - 09:50:57) and
338 sec [09:53:42 - 09:59:20)

3.1.2.3 Numerical example: Internal ED state (1 unit over 2 days (Mondays) at same time)



Data sample: SELECT visit_details.* INTO data_sample FROM visit_details WHERE (entry_group=1 AND department=1 AND entry_date < #5/08/2006 20:00:00# AND exit_date > #5/08/2006 19:00:00#);

#	patient id	medical id	gender	department	entry date	exit date	outcome	age years	age months
1	10050255	20087589	2	1	03/May/2006 22:44:20	12/May/2006 02:29:20	7	26	4
2	10117940	20222451	1	1	08/May/2006 08:27:25	08/May/2006 23:50:00	9	76	6
3	10011308	20015032	2	1	08/May/2006 09:57:31	08/May/2006 20:48:51	7	43	1
4	10068408	20114960	2	1	08/May/2006 10:50:55	08/May/2006 20:08:54	2	56	7
5	10163430	20293859	1	1	08/May/2006 10:51:39	08/May/2006 23:50:00	9	19	2
6	10117142	20295194	1	1	08/May/2006 11:14:24	08/May/2006 22:34:50	7	45	4
7	10011299	20015012	2	1	08/May/2006 11:20:21	08/May/2006 19:11:23	2	74	4
8	10137516	20277589	1	1	08/May/2006 12:56:42	08/May/2006 22:01:21	2	72	10
9	10146544	20295099	1	1	08/May/2006 13:14:24	08/May/2006 19:14:01	7	61	4
10	10151823	20272033	1	1	08/May/2006 14:15:42	08/May/2006 19:11:23	2	81	9
11	10164029	20294953	1	1	08/May/2006 14:15:49	08/May/2006 20:45:43	7	31	5
12	10012598	20017244	2	1	08/May/2006 14:33:47	08/May/2006 19:23:39	7	33	8
13	10174062	20318799	1	1	08/May/2006 15:13:18	08/May/2006 21:33:46	2	53	10
14	10051406	20102555	2	1	08/May/2006 15:22:48	08/May/2006 21:51:23	2	18	11
15	10034953	20114952	2	1	08/May/2006 15:25:47	08/May/2006 19:11:59	2	58	10
16	10009410	20015040	2	1	08/May/2006 15:26:42	08/May/2006 19:34:36	2	54	2
17	10131548	20329939	1	1	08/May/2006 15:27:11	09/May/2006 04:01:53	2	50	9
18	10012614	20017264	2	1	08/May/2006 15:37:57	08/May/2006 20:57:17	7	89	6
19	10154092	20276933	1	1	08/May/2006 15:45:43	08/May/2006 19:24:04	2	40	0
20	10003715	20004460	2	1	08/May/2006 15:50:26	08/May/2006 19:16:33	2	64	3
21	10116543	20220487	1	1	08/May/2006 15:51:54	08/May/2006 19:15:51	2	78	6
22	10116547	20220491	1	1	08/May/2006 16:05:56	09/May/2006 02:05:33	2	39	4
23	10020941	20087631	2	1	08/May/2006 16:20:56	08/May/2006 23:06:09	7	87	10
24	10116105	20295131	1	1	08/May/2006 16:27:32	08/May/2006 23:48:16	7	73	4
25	10164125	20295132	1	1	08/May/2006 16:28:24	08/May/2006 19:12:24	7	71	5
26	10173593	20317070	1	1	08/May/2006 16:30:26	08/May/2006 20:44:00	2	70	4
27	10055567	20087636	2	1	08/May/2006 16:37:53	08/May/2006 19:35:45	7	73	10
28	10030148	20114973	2	1	08/May/2006 16:48:21	08/May/2006 19:42:40	2	43	7
29	10147177	20263000	1	1	08/May/2006 17:09:46	08/May/2006 21:07:19	2	43	3
30	10011355	20066017	2	1	08/May/2006 17:19:46	08/May/2006 22:18:39	7	72	4
31	10164144	20295170	1	1	08/May/2006 17:21:42	08/May/2006 22:04:36	7	39	7
32	10172127	20313629	1	1	08/May/2006 17:29:26	08/May/2006 19:47:09	2	82	4
33	10006371	20087649	2	1	08/May/2006 17:30:17	08/May/2006 19:47:53	7	46	10
34	10113697	20220512	1	1	08/May/2006 17:50:52	08/May/2006 20:18:34	2	82	1
35	10171693	20312423	1	1	08/May/2006 17:53:25	08/May/2006 20:45:42	2	20	4
36	10112674	20222599	1	1	08/May/2006 18:07:51	09/May/2006 00:01:02	7	77	7
37	10058532	20099193	2	1	08/May/2006 18:08:43	09/May/2006 03:37:23	2	21	2
38	10140598	20293855	1	1	08/May/2006 18:17:27	08/May/2006 23:50:00	9	20	7
39	10140049	20294908	1	1	08/May/2006 18:23:49	08/May/2006 21:16:04	7	26	7
40	10002649	20015010	2	1	08/May/2006 18:24:59	08/May/2006 23:46:35	2	66	4
41	10022644	20087476	2	1	08/May/2006 18:34:18	08/May/2006 19:14:34	7	84	4
42	10000144	20015013	2	1	08/May/2006 18:35:27	08/May/2006 23:45:00	2	60	2
43	10038052	20087492	2	1	08/May/2006 18:35:29	08/May/2006 21:48:39	7	33	1
44	10055622	20087493	2	1	08/May/2006 18:37:42	08/May/2006 19:53:55	7	18	8
45	10164016	20294933	1	1	08/May/2006 18:44:27	09/May/2006 00:51:59	7	20	4
46	10007344	20017232	2	1	08/May/2006 18:44:39	09/May/2006 01:34:10	7	92	1
47	10180549	20329919	1	1	08/May/2006 19:00:51	08/May/2006 22:27:49	2	65	1
48	10000489	20015017	2	1	08/May/2006 19:02:29	09/May/2006 01:26:02	2	74	4
49	10118066	20222611	1	1	08/May/2006 19:25:54	09/May/2006 00:42:28	7	73	6
50	10022011	20030386	2	1	08/May/2006 19:38:38	08/May/2006 22:04:47	2	67	2
51	10011302	20015020	2	1	08/May/2006 19:43:39	09/May/2006 02:29:25	2	68	8
52	10129199	20264582	1	1	08/May/2006 19:47:44	08/May/2006 19:48:26	2	51	0
53	10003211	20015021	2	1	08/May/2006 19:47:55	09/May/2006 08:01:21	7	75	0
54	10130693	20329923	1	1	08/May/2006 19:58:49	09/May/2006 01:16:34	2	82	8

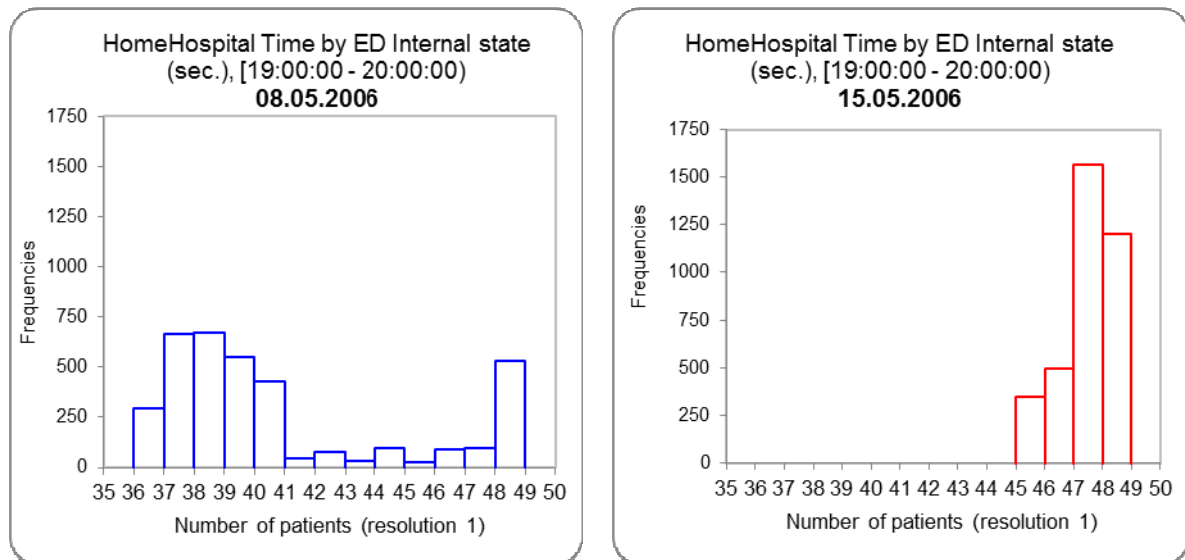
Data sample: SELECT visit_details.* INTO data_sample FROM visit_details WHERE (entry_group=1 AND department=1 AND entry_date < #5/15/2006 20:00:00# AND exit_date > #5/15/2006 19:00:00#);

#	patient id	medical id	gender	department	entry date	exit date	outcome	age years	age months
1	10043846	20066002	2	1	15/May/2006 00:49:01	16/May/2006 09:25:00	7	28	3
2	10008600	20017042	2	1	15/May/2006 04:25:10	15/May/2006 23:50:00	9	31	10
3	10118068	20222613	1	1	15/May/2006 08:14:53	15/May/2006 23:50:00	7	51	11
4	10116527	20220468	1	1	15/May/2006 09:55:10	15/May/2006 23:25:57	2	56	4
5	10116532	20220473	1	1	15/May/2006 10:44:26	16/May/2006 09:04:27	2	68	4
6	10156924	20313626	1	1	15/May/2006 10:59:42	15/May/2006 19:09:45	2	38	9
7	10117941	20222452	1	1	15/May/2006 11:04:39	15/May/2006 23:50:00	9	80	5
8	10055255	20086726	2	1	15/May/2006 11:44:02	15/May/2006 23:50:00	9	54	4
9	10055661	20087577	2	1	15/May/2006 13:06:37	15/May/2006 21:30:10	7	29	11
10	10055684	20087644	2	1	15/May/2006 13:49:45	16/May/2006 07:39:48	7	20	2
11	10001574	20017233	2	1	15/May/2006 14:30:27	15/May/2006 20:52:55	7	80	5
12	10164034	20294961	1	1	15/May/2006 14:34:20	15/May/2006 23:21:48	7	40	1
13	10116513	20220453	1	1	15/May/2006 14:40:53	15/May/2006 20:37:44	2	54	11
14	10011247	20114934	2	1	15/May/2006 14:44:16	15/May/2006 20:36:43	2	83	4
15	10011305	20015026	2	1	15/May/2006 14:48:20	15/May/2006 20:27:49	2	85	0
16	10030067	20087552	2	1	15/May/2006 14:59:07	15/May/2006 19:28:22	7	85	1
17	10164064	20295023	1	1	15/May/2006 15:01:20	15/May/2006 21:31:08	7	50	6
18	10116538	20220480	1	1	15/May/2006 15:20:54	15/May/2006 23:43:47	2	80	11
19	10170133	20313619	1	1	15/May/2006 15:22:00	15/May/2006 21:14:55	2	76	7
20	10045549	20086727	2	1	15/May/2006 15:29:04	15/May/2006 23:50:00	9	90	2
21	10164103	20295093	1	1	15/May/2006 15:53:11	15/May/2006 22:22:57	7	70	4
22	10113227	20295114	1	1	15/May/2006 16:00:25	15/May/2006 20:13:52	7	62	8
23	10116549	20220494	1	1	15/May/2006 16:30:53	15/May/2006 21:24:35	2	77	3
24	10164140	20295164	1	1	15/May/2006 16:53:31	15/May/2006 20:04:21	7	72	9
25	10164141	20295165	1	1	15/May/2006 16:56:10	15/May/2006 19:36:46	7	19	9
26	10114337	20353722	1	1	15/May/2006 17:05:32	16/May/2006 11:39:29	14	69	4
27	10164142	20295166	1	1	15/May/2006 17:12:40	15/May/2006 19:42:59	7	68	4
28	10116554	20220501	1	1	15/May/2006 17:21:34	15/May/2006 23:46:51	2	50	3
29	10055685	20087645	2	1	15/May/2006 17:32:54	15/May/2006 20:33:47	7	25	10
30	10026565	20037179	2	1	15/May/2006 17:34:11	15/May/2006 19:30:25	7	64	8
31	10138837	20329963	1	1	15/May/2006 17:34:45	15/May/2006 20:02:22	2	58	5
32	10180556	20329964	1	1	15/May/2006 17:36:16	15/May/2006 22:01:33	2	91	4
33	10123504	20295188	1	1	15/May/2006 17:37:00	15/May/2006 23:34:17	7	53	7
34	10039992	20087657	2	1	15/May/2006 17:39:40	15/May/2006 22:21:46	7	31	1
35	10001570	20017043	2	1	15/May/2006 17:49:22	15/May/2006 23:50:00	9	58	7
36	10152497	20295190	1	1	15/May/2006 18:09:16	15/May/2006 23:39:30	7	72	4
37	10055692	20087658	2	1	15/May/2006 18:16:14	15/May/2006 21:04:43	7	52	0
38	10131948	20240412	1	1	15/May/2006 18:21:52	15/May/2006 19:56:39	2	68	4
39	10131949	20240413	1	1	15/May/2006 18:23:14	15/May/2006 20:40:02	2	45	11
40	10172386	20314440	1	1	15/May/2006 18:32:47	16/May/2006 01:21:58	2	66	4
41	10131406	20313612	1	1	15/May/2006 18:41:56	16/May/2006 04:35:01	2	77	3
42	10005939	20017223	2	1	15/May/2006 18:47:59	16/May/2006 00:00:32	7	29	10
43	10055610	20087468	2	1	15/May/2006 18:48:23	16/May/2006 00:17:38	7	50	9
44	10114471	20220435	1	1	15/May/2006 18:50:04	16/May/2006 06:49:20	2	81	11
45	10114250	20294899	1	1	15/May/2006 18:50:53	15/May/2006 22:49:02	7	59	4
46	10163993	20294900	1	1	15/May/2006 18:57:45	15/May/2006 22:52:10	7	58	6
47	10114532	20220436	1	1	15/May/2006 19:02:03	15/May/2006 19:27:41	2	57	3
48	10173330	20316309	1	1	15/May/2006 19:09:51	16/May/2006 12:30:00	2	71	0
49	10138831	20294919	1	1	15/May/2006 19:18:23	15/May/2006 22:20:20	7	70	0
50	10008364	20028365	2	1	15/May/2006 19:34:45	15/May/2006 21:44:40	2	76	4
51	10138750	20294920	1	1	15/May/2006 19:38:10	15/May/2006 21:40:26	7	22	4
52	10055618	20087482	2	1	15/May/2006 19:40:08	15/May/2006 19:50:00	7	52	1
53	10164010	20294921	1	1	15/May/2006 19:40:29	15/May/2006 23:16:26	7	19	8
54	10020212	20087483	2	1	15/May/2006 19:43:32	16/May/2006 06:09:35	7	62	4
55	10162796	20294943	1	1	15/May/2006 19:54:54	15/May/2006 20:04:00	7	36	4

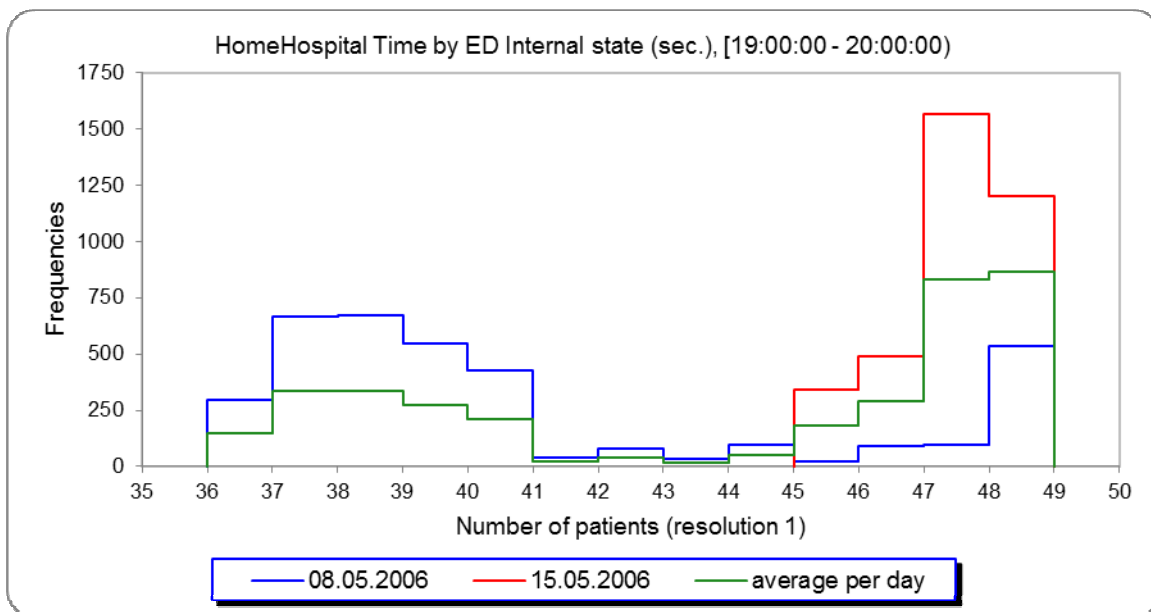
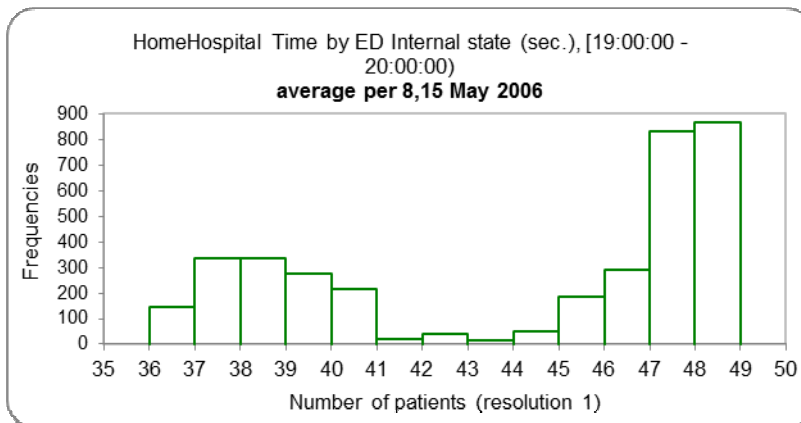
First find the $N_{\text{at moment } i}$ for 08.05.2006 and 15.05.2006 at time interval [19:00:00 - 20:00:00).

Emergency Internal Medicine Unit					
08.05.2006			15.05.2006		
Time	number of patients	duration (seconds)	Time	number of patients	duration (seconds)
[19:00:00 - 19:00:51]	46	52	[19:00:00 - 19:02:03]	46	124
[19:00:51 - 19:02:29]	47	98	[19:02:03 - 19:09:45]	47	462
[19:02:29 - 19:11:23]	48	534	[19:09:45 - 19:09:51]	46	6
[19:11:23 - 19:11:59]	46	36	[19:09:51 - 19:18:23]	47	512
[19:11:59 - 19:12:24]	45	25	[19:18:23 - 19:27:41]	48	558
[19:12:24 - 19:14:01]	44	97	[19:27:41 - 19:28:22]	47	41
[19:14:01 - 19:14:34]	43	33	[19:28:22 - 19:30:25]	46	123
[19:14:34 - 19:15:51]	42	77	[19:30:25 - 19:34:45]	45	260
[19:15:51 - 19:16:33]	41	42	[19:34:45 - 19:36:46]	46	121
[19:16:33 - 19:23:39]	40	426	[19:36:46 - 19:38:10]	45	84
[19:23:39 - 19:24:04]	39	25	[19:38:10 - 19:40:08]	46	118
[19:24:04 - 19:25:54]	38	110	[19:40:08 - 19:40:29]	47	21
[19:25:54 - 19:34:36]	39	522	[19:40:29 - 19:42:59]	48	150
[19:34:36 - 19:35:45]	38	69	[19:42:59 - 19:43:32]	47	33
[19:35:45 - 19:38:38]	37	173	[19:43:32 - 19:50:00]	48	388
[19:38:38 - 19:42:40]	38	242	[19:50:00 - 19:54:54]	47	294
[19:42:40 - 19:43:39]	37	59	[19:54:54 - 19:56:39]	48	105
[19:43:39 - 19:47:09]	38	210	[19:56:39 - 20:00:00]	47	200
[19:47:09 - 19:47:44]	37	35			
[19:47:44 - 19:48:26]	38	42			
[19:48:26 - 19:53:55]	37	329			
[19:53:55 - 19:58:49]	36	294			
[19:58:49 - 20:00:00]	37	70			

Second compute frequencies of the time-interval for 08.05.2006 and 15.05.2006.



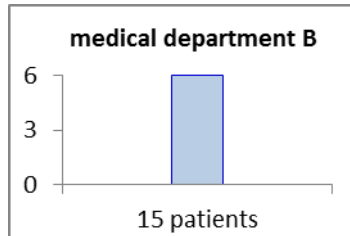
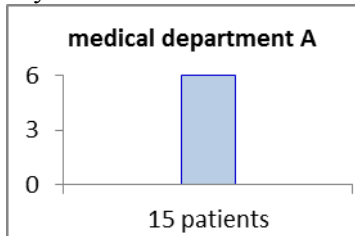
And last step find daily average of frequencies of days 08.05.2006 and 15.08.2006.



Time by ED Internal state (sec.), [19:00:00 - 20:00:00]			
number of patients	Frequency		
	08.05.2006	15.05.2006	average per day 08.05.2006 and 15.05.2006
36	294	0	147
37	668	0	334
38	671	0	336
39	547	0	274
40	426	0	213
41	42	0	21
42	77	0	39
43	33	0	17
44	97	0	49
45	25	344	185
46	88	492	290
47	98	1563	831
48	534	1201	868

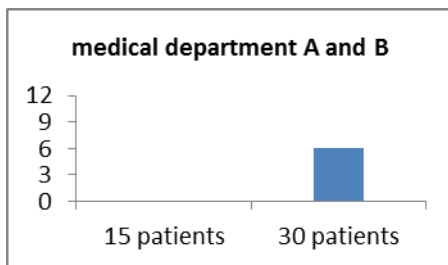
3.1.2.4 Exercise (find out number of patients in 2 units over 1 day)

Consider the following scenario: 15 patients were treated during 6 hours in medical department A on a particular day, 15 patients were treated during 6 hours in medical department B on the same day.

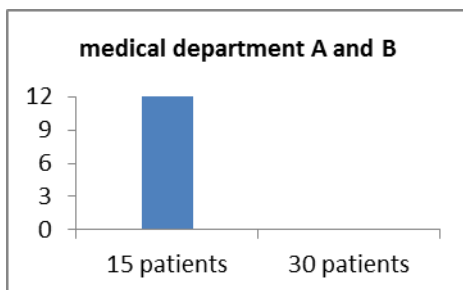


Which of the following is correct when looking at A and B together?

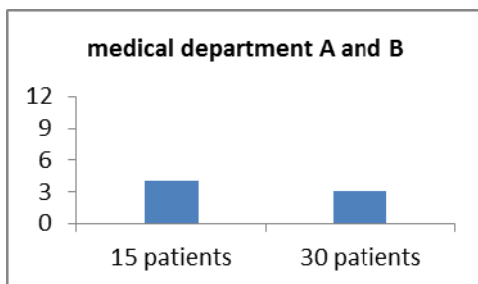
A) 30 patients were treated during 6 hours



B) 15 patients were treated during 12 hours



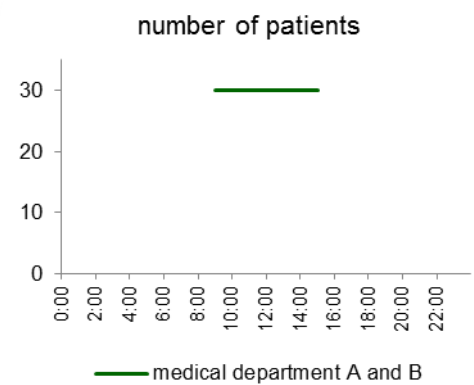
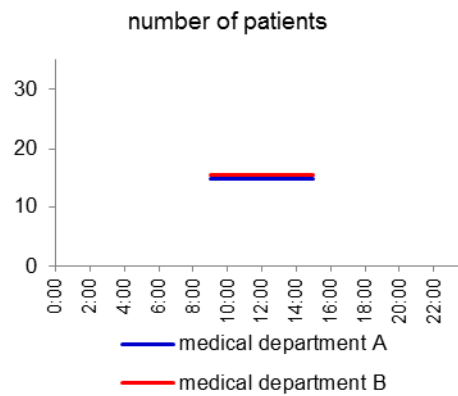
C) 30 patients were treated during 3 hours and 15 patients were treated during 4 hours



All of the above may be correct. See below graphs of each medical department state.

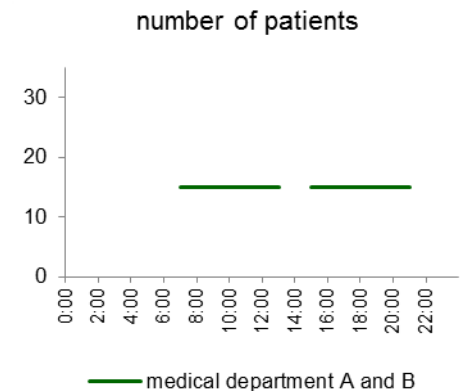
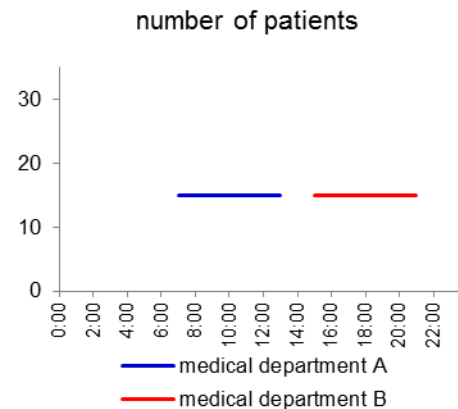
A) 30 patients were treated during 6 hours

time	number of patients		
	A	B	A and B
0:00			
1:00			
2:00			
3:00			
4:00			
5:00			
6:00			
7:00			
8:00			
9:00	15	15	30
10:00	15	15	30
11:00	15	15	30
12:00	15	15	30
13:00	15	15	30
14:00	15	15	30
15:00	15	15	30
16:00			
17:00			
18:00			
19:00			
20:00			
21:00			
22:00			
23:00			



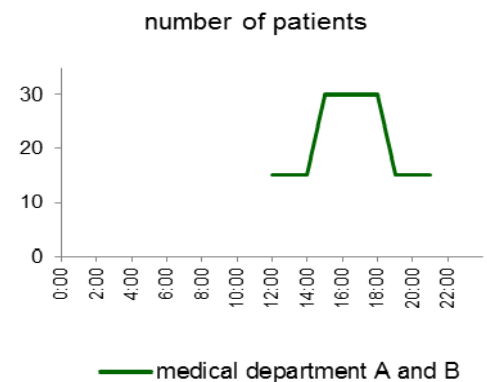
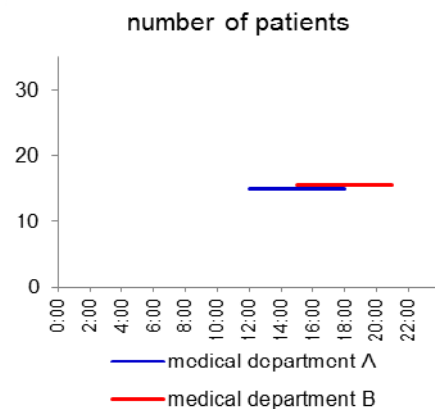
B) 15 patients were treated during 12 hours

time	number of patients		
	A	B	A and B
0:00			
1:00			
2:00			
3:00			
4:00			
5:00			
6:00			
7:00	15		15
8:00	15		15
9:00	15		15
10:00	15		15
11:00	15		15
12:00	15		15
13:00	15		15
14:00		15	15
15:00		15	15
16:00		15	15
17:00		15	15
18:00		15	15
19:00		15	15
20:00		15	15
21:00		15	15
22:00			
23:00			



C) 30 patients were treated during 3 hours and 15 patients were treated during 4 hours

time	number of patients		
	A	B	A and B
0:00			
1:00			
2:00			
3:00			
4:00			
5:00			
6:00			
7:00			
8:00			
9:00			
10:00			
11:00			
12:00	15		15
13:00	15		15
14:00	15		15
15:00	15	15	30
16:00	15	15	30
17:00	15	15	30
18:00	15	15	30
19:00		15	15
20:00		15	15
21:00		15	15
22:00			
23:00			



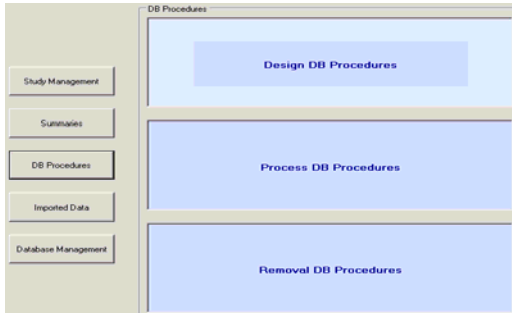
3.2 Creation of the variable by SEESat

3.2.1 Calculating the number of patients during the day by “instants count” procedure

If user extension was not configured first, it is necessary to define it and only then start building procedure (see [Appendix 6](#) Creation SEESat user extension).

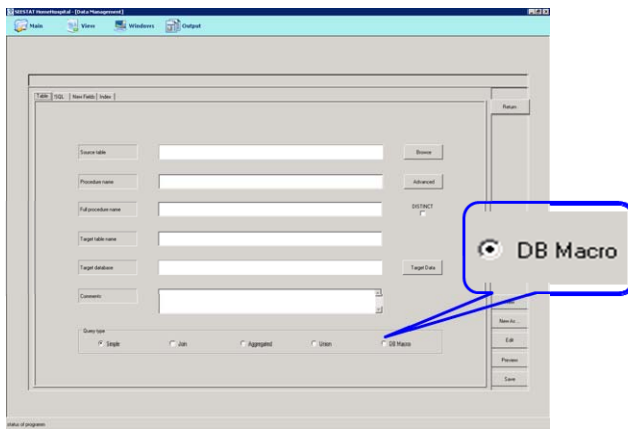
Click Main-> Data Management

Click DB Procedures -> Design DB Procedures

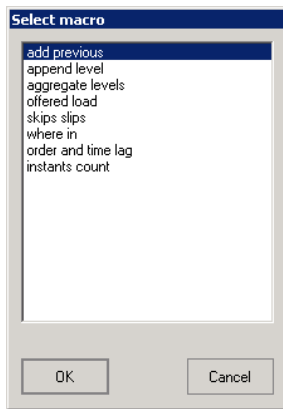


Select study HomeHospital (if needed).

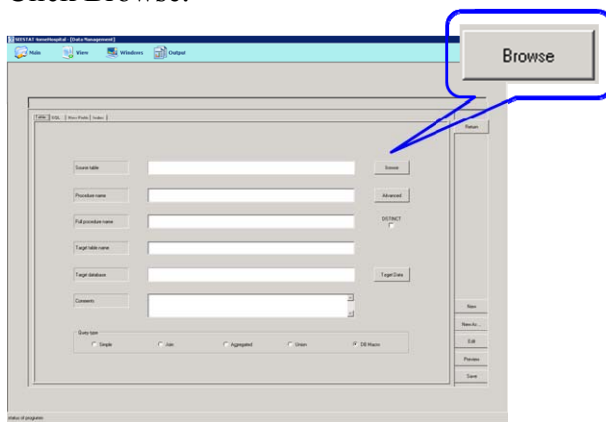
Select radio-button DB Macro



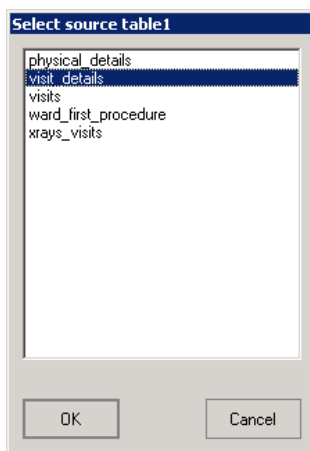
Select *add previous* type of macro and click OK. This type of macro procedure adds previous table data to current table data. For example: this procedure combines prev_visits_detail table and visits_detail table. Prev_visits_details table includes records of hospital visits for previous months. Procedure combines all records: records that started in current month and records that started in previous months and end after current month (a detailed description of the visit_details table can be found in <http://ie.technion.ac.il/Labs/Serveng/files/HHD/database.pdf>).



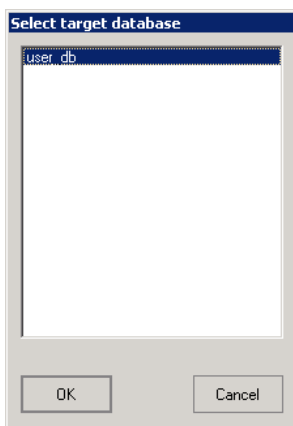
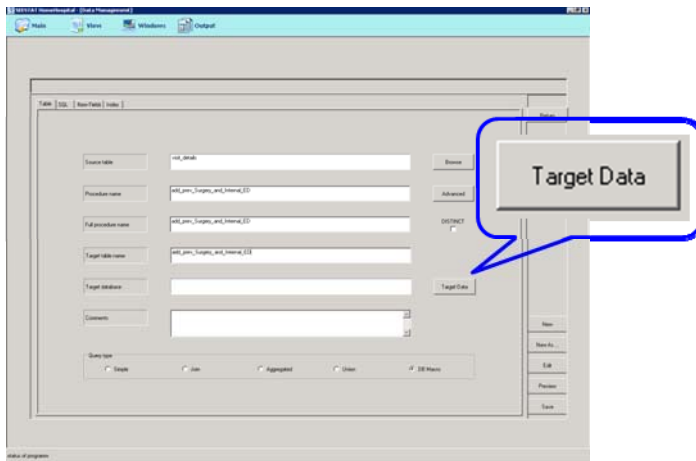
Click Browse.



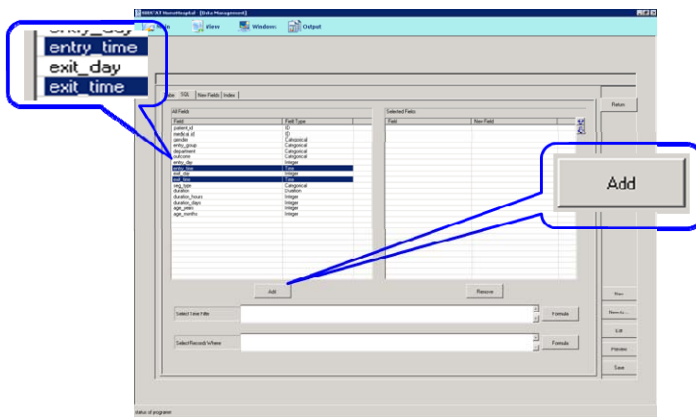
Select visit_detail table, click OK



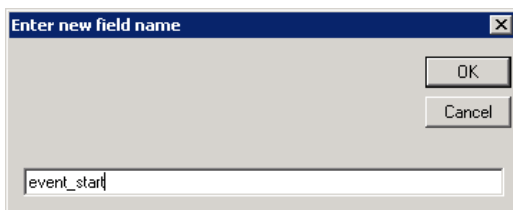
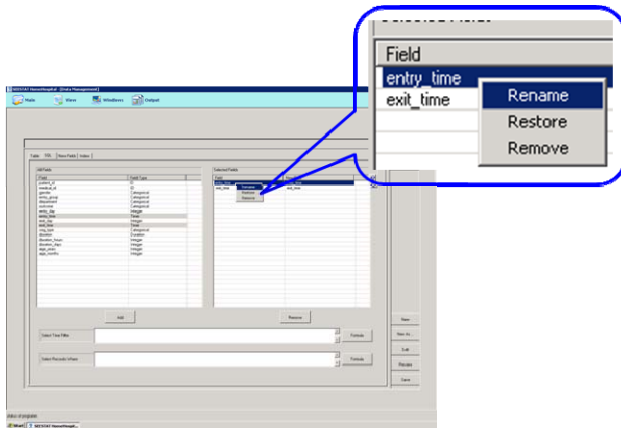
Fill in procedure name, full procedure name and target table name
add_prev_Surgery_and_Internal_ED. Click button Target Data and select target database
user_db, click OK.



Click tab SQL. Select *entry_time* and *exit_time* fields, click button Add.

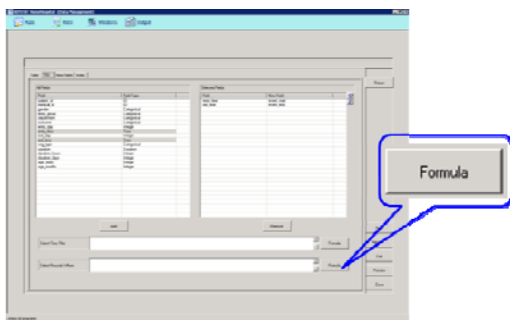


Right click on *entry_time* and rename to *event_start*, click OK



Right click on *exit_time* and rename to *event_end*, click OK

Click [Formula](#) button in *Select Records Where* frame.



Fill in formula: *entry_group = 1 and duration_days < 30 and (department = 1 or department = 2)*

(see [Appendix 7](#) How to type formula in SEESat).

Formula Dialog

entry_group = 1 and duration_days < 30 and (department = 1 or department = 2)

Undo

Field name	Field type		Operators/functions	
patient_id	ID		(	
medical_id	ID		)	
gender	Categorical		and	
entry_group	Categorical		or	
department	Categorical		not	
outcome	Categorical		=	
entry_day	Integer		<>	
entry_time	Time		<	
exit_day	Integer		<=	
exit_time	Time		>	
seg_type	Categorical		>=	
duration	Duration			
duration_hours	Integer			
duration_days	Integer			
age_years	Integer			
age_months	Integer			

Scalars

Number

Time (hh:mm:ss)

Functions

Cancel OK

Click OK and Save.

Notes:

- Codes for entry_group, department and other categorical fields can be found in SEESat interface: View → Dictionary or in <http://ie.technion.ac.il/Labs/Serveng/files/HHD/database.pdf>;
- For creation *Time by ED (without Pediatric Units) state (sec.)* use filter where: *entry_group = 1 and duration_days < 30 and (department <> 9 and department <> 10)* (For finding necessary codes: click View → Dictionary → hospital_unit: 9-Pediatric Emergency Unit, 10-Pediatric Emergency Surgery Unit)

View Dictionaries

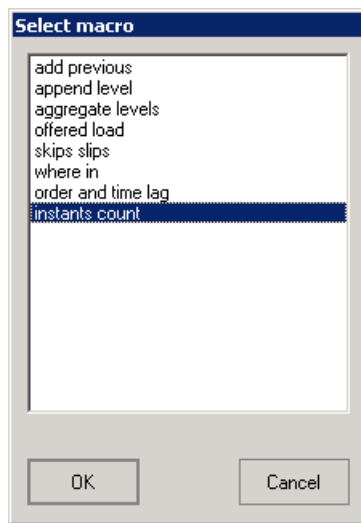
Dictionary	Code	Name
entry_group	0	Total
gender	1	Emergency Internal Medicine Unit
outcome	2	Emergency Surgery Unit
entry_exit	3	Emergency Traumatology Unit
department	4	Emergency Orthopedic Unit
ward_department	5	Emergency Otorhinolaryngology Unit
hospital_unit	6	Emergency Ophthalmology Unit
outcome_id	7	Emergency Psychiatry Unit
intensive_care_unit	8	Emergency Gynecology Unit
pediatric_unit	9	Pediatric Emergency Unit
physical_hospital_unit	10	Pediatric Emergency Surgery Unit
Time_interval	11	Emergency Maternity Unit
Day_time	12	Chemotherapy Outpatient Center
Day_time2	13	Institute of Oncology
	14	Chemotherapy Inpatient Oncology Unit
	15	Radiotherapy Inpatient Oncology Unit
	16	Institute for Immunology, Allergy and AIDS
	17	Institute of Gastroenterology
	18	Intensive Care Unit Gastroenterology
	19	Institute of Hematology and Bone Marrow Transplant
	20	Pediatric Hematology and Oncology Department2
	21	Institute of Hematology and Bone Marrow Transplant1
	22	Thrombosis and Hemostasis Unit
	23	Department of Intensive and Critical Medicine
	24	Department of Neurology
	25	Cognitive Neurology Unit
	26	Institute EEG

- `duration_days < 30` - there are a few records with possibly incorrect times, see example below

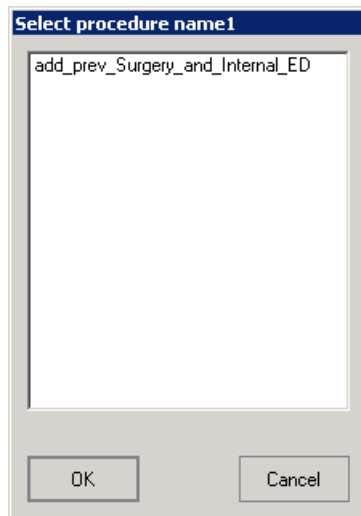
patient_id	medical_id	entry_group	department	entry_date	exit_date	outcome	duration_days
10086416	20208896	1	8	14/11/2004 18:39	20/03/2006 18:24	7	491
10109070	20203816	1	7	19/01/2004 11:11	18/01/2005 16:00	7	365
10112397	20215749	1	5	29/12/2004 18:10	09/02/2005 18:11	7	42
10066764	20111655	1	2	07/03/2006 15:10	07/04/2006 17:00	7	31
10145911	20314046	1	1	17/06/2005 10:42	17/07/2005 13:11	7	30

Click Return and Design DB Procedures.

Select button DB Macro and select macro type *instants count*, click OK.



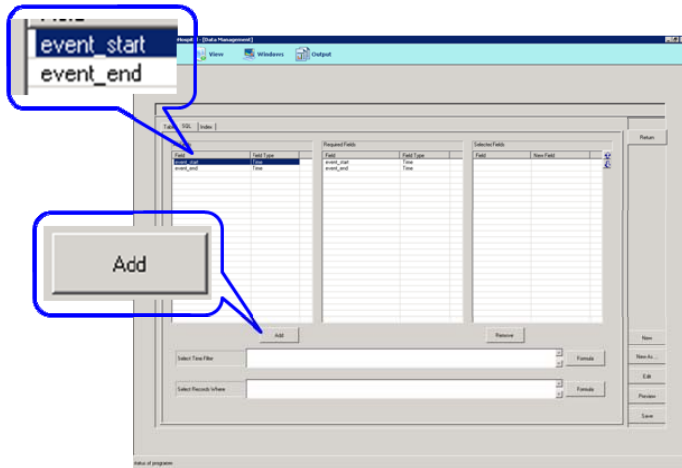
Click button Browse and select *add_prev_Surgery_and_Internal_ED procedure*, click OK.



Fill in procedure name, full procedure name and target table name

Surgery_and_Internal_ED_count. Click button Target Data and select target database *user_db*, click OK.

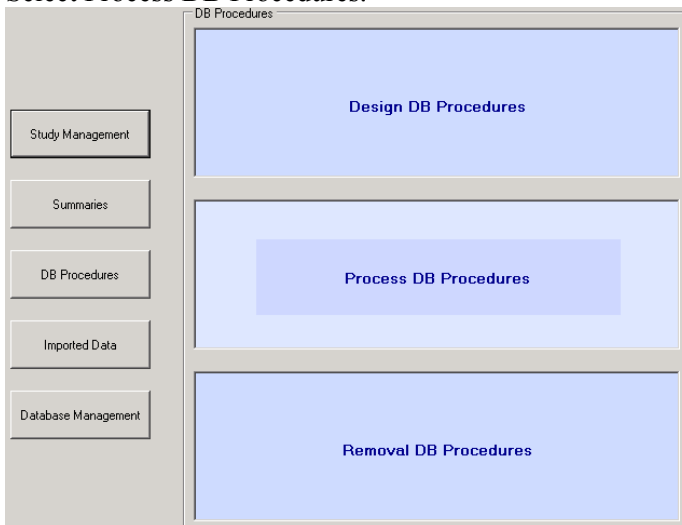
In SQL tab select event_start and click button Add, select event_end and click button Add.



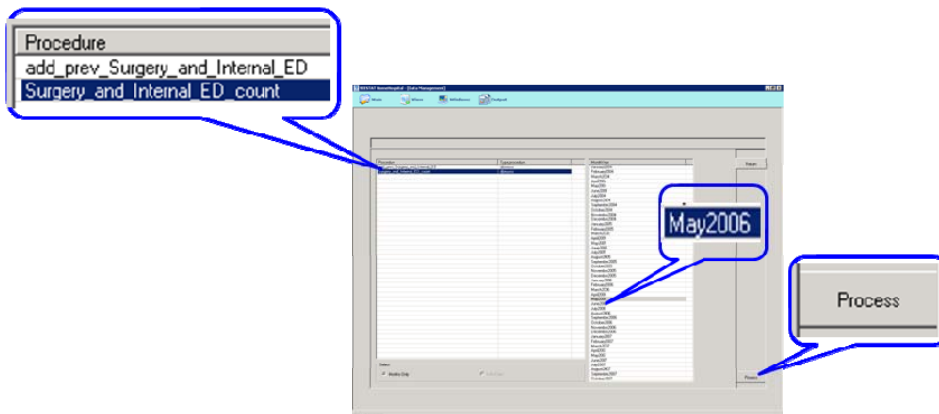
Click Save.

Click Return.

Select Process DB Procedures.



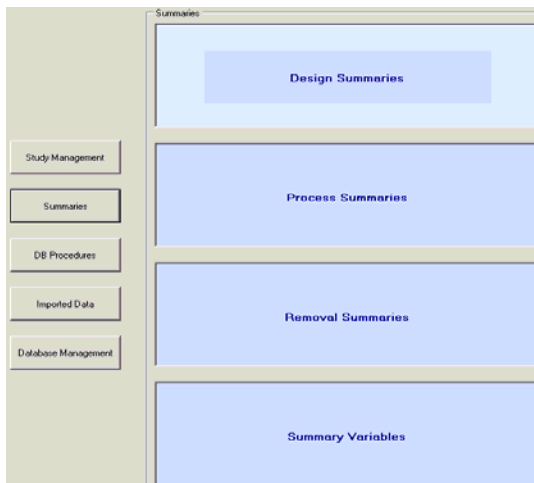
Select Surgery_and_Internal_ED_count and May 2006. Click Process. Wait a few seconds.



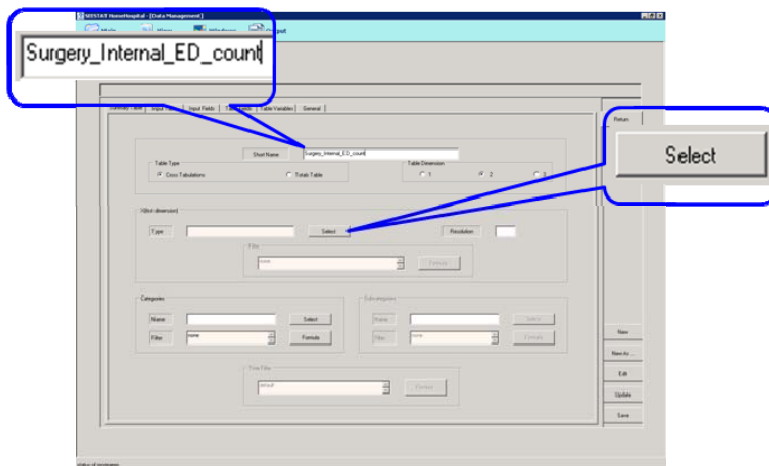
3.2.2 Creating ED state during the day on the basis of “instants count” procedure

Click Return.

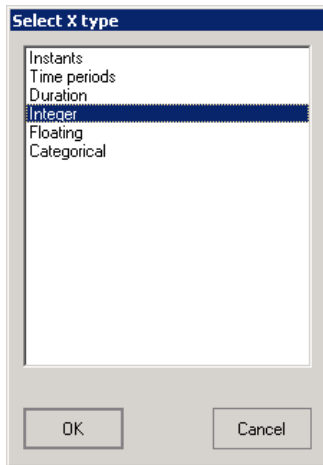
Select Summaries → Design Summaries



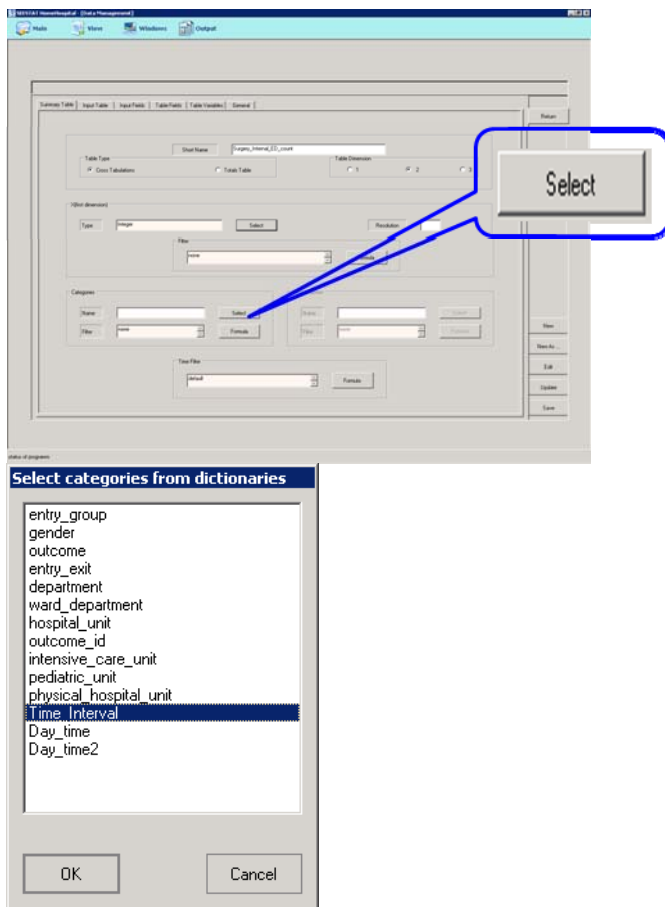
Fill in name of summaries *Surgery_Internal_ED_count*. Click on button Select in *X (first dimension)* frame.



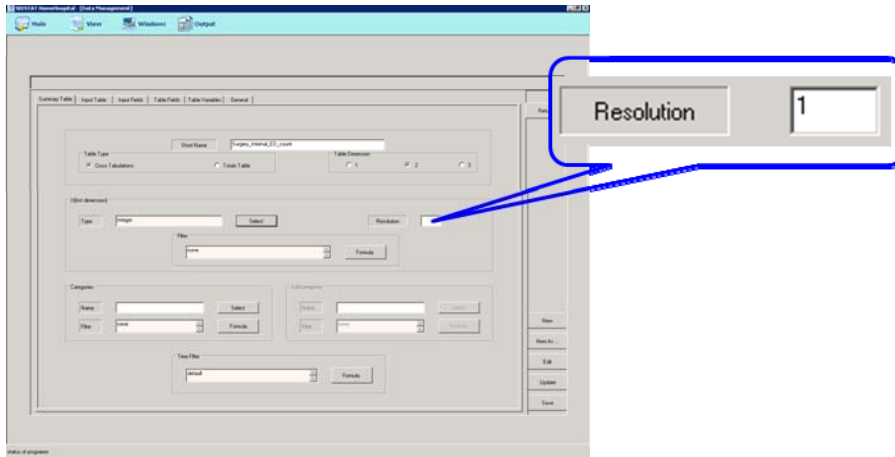
Select X type Integer and OK.



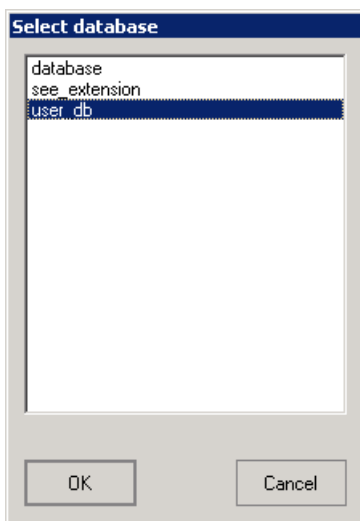
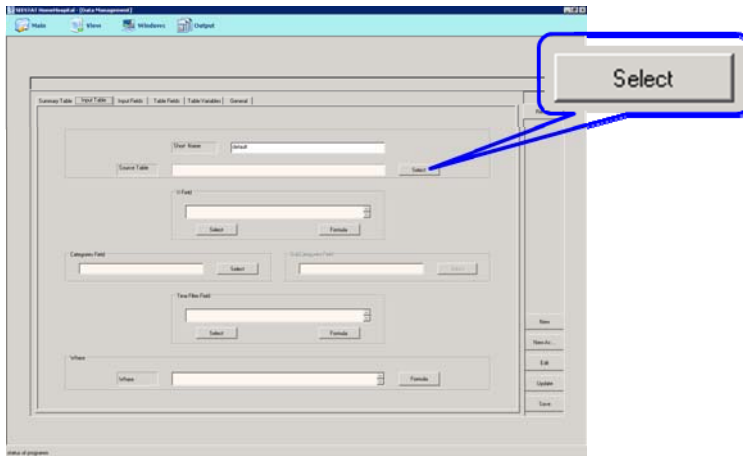
Click on button Select in *Categories* frame and select *Time_Interval* dictionary and OK.

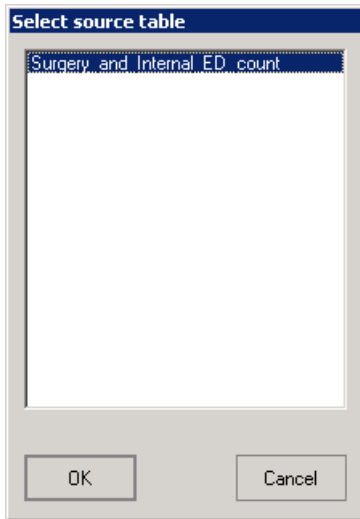


Fill in resolution 1 in *X (first dimension)* frame.

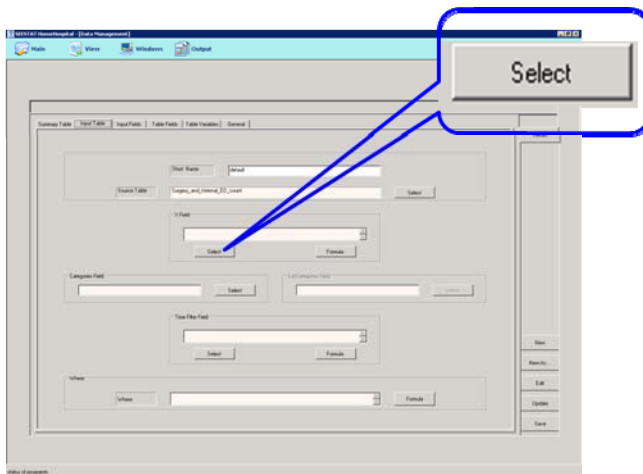


In **Input Table** Tab, click on button **Select**, select **user_db** database, **OK** and **Surgery_and_Internal_ED_count**, **OK**

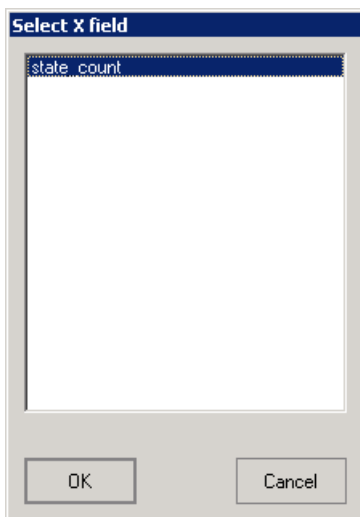




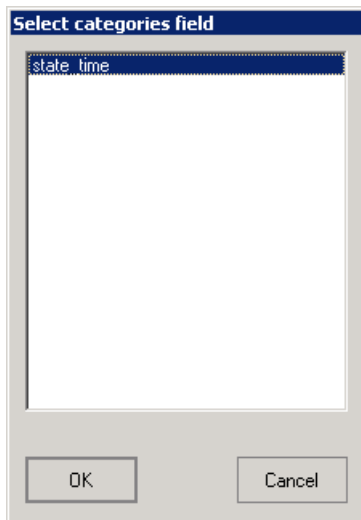
Click on Select button in *X field* frame.



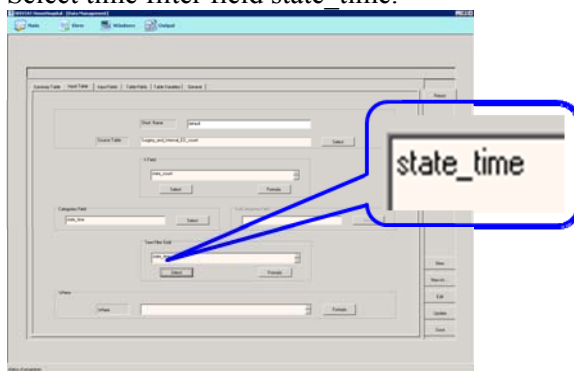
Select state_count field.



Select categories field state_time.



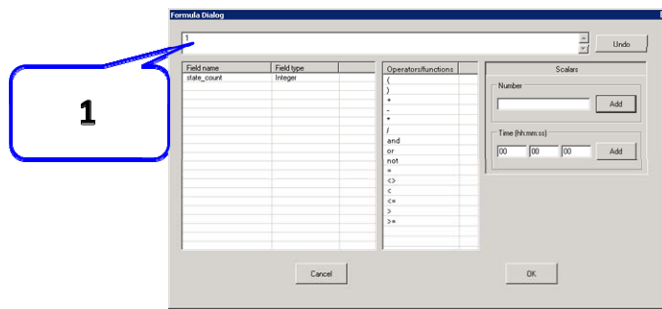
Select time filter field state_time.



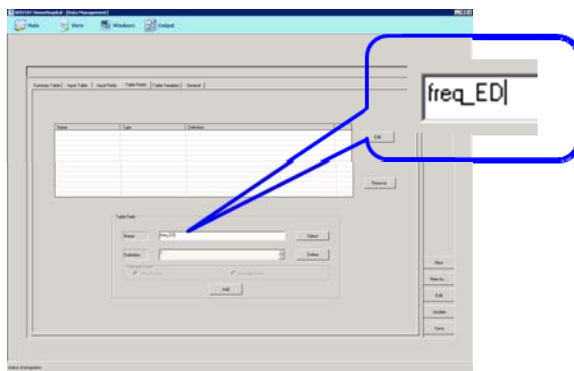
In **Input Fields** tab select state_count field.



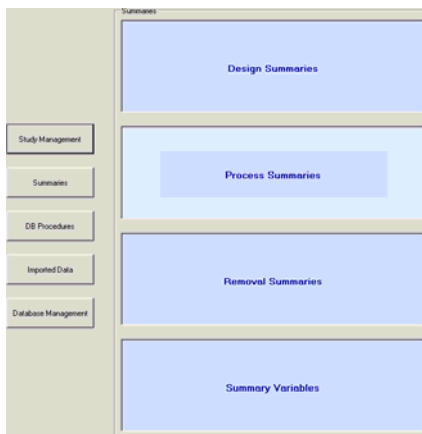
In **Table Fields** click **Define** button and fill in number **1** in formula, click OK



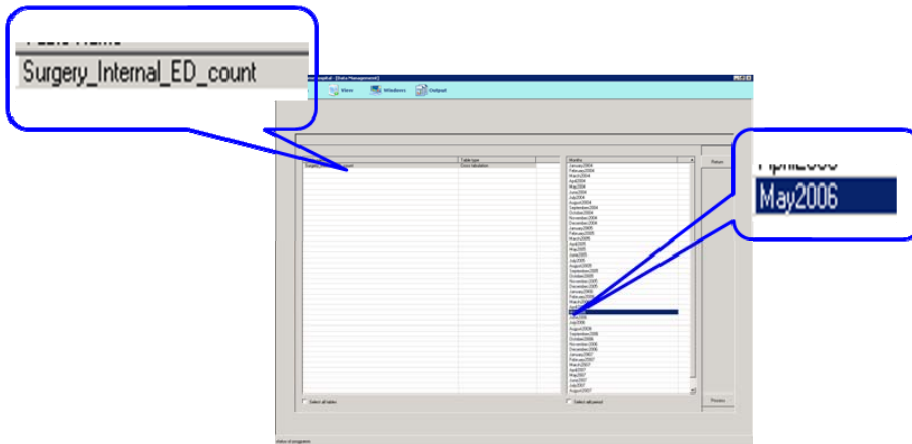
Fill in *freq_ED* name , click Add button.



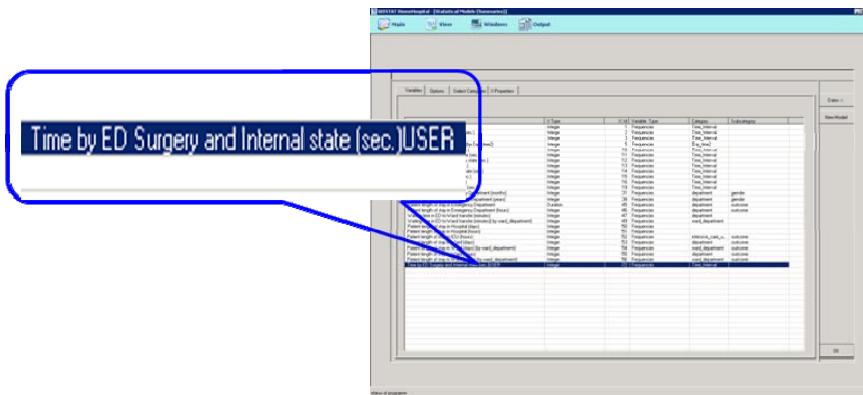
In **Table Variables** tab select *freq_ED* and fill in name *Time by ED Surgery and Internal state (sec.) USER*, click Add button. Click Save. Click Return and Process Summaries.



Select Surgery_Internal_Ed_count, May 2006 and click Process button.

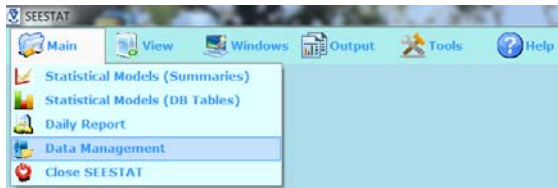


After end of process summary, reopen SEESat.

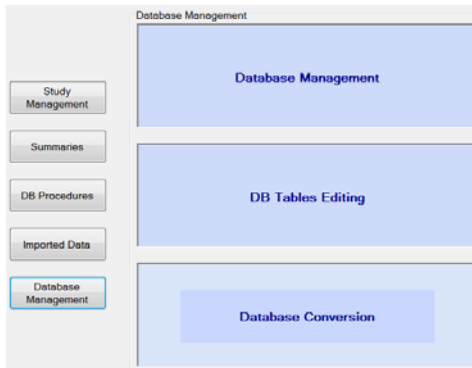


Appendix 4: How export data table from SEESTat

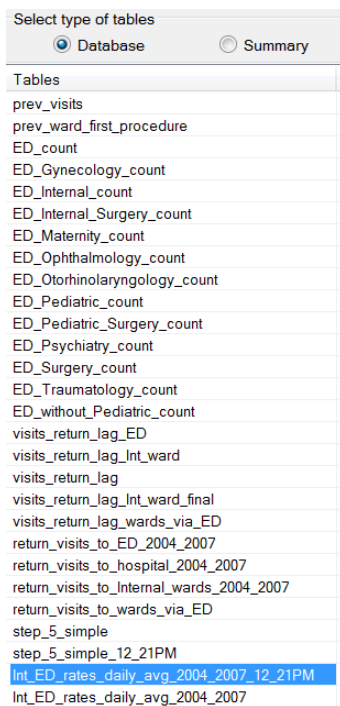
Click Main->Data Management



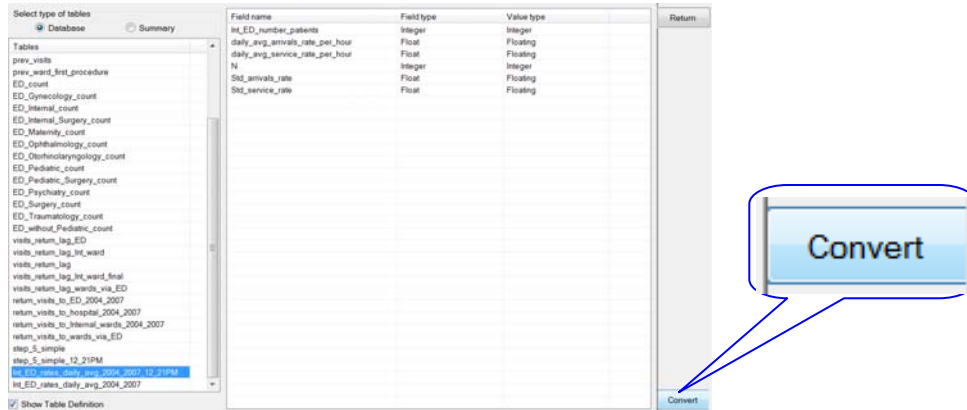
Select Database Management->Database Conversion



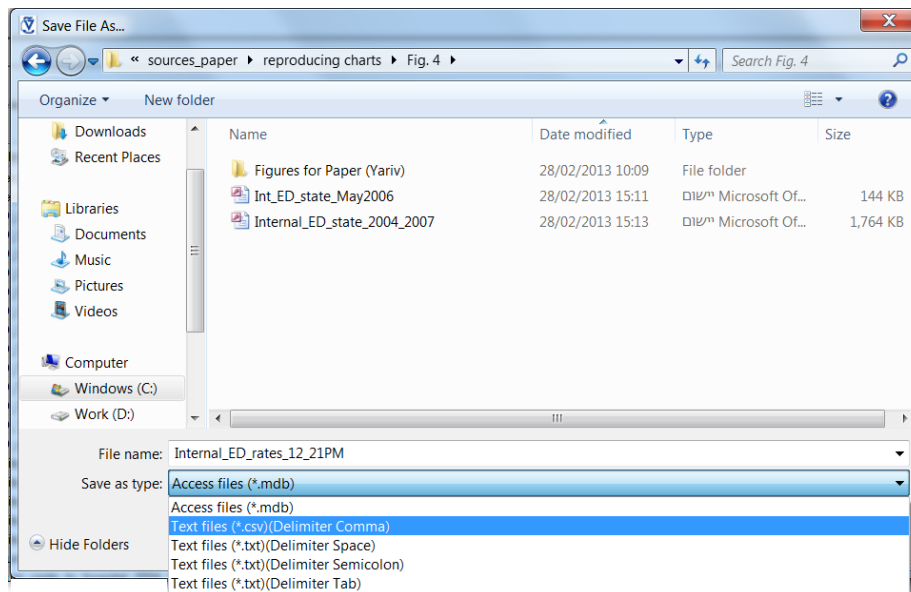
Select type of tables **Database** and select table **Int_ED_rates_avg_2004_2007_12_21PM**



Click **Convert** button

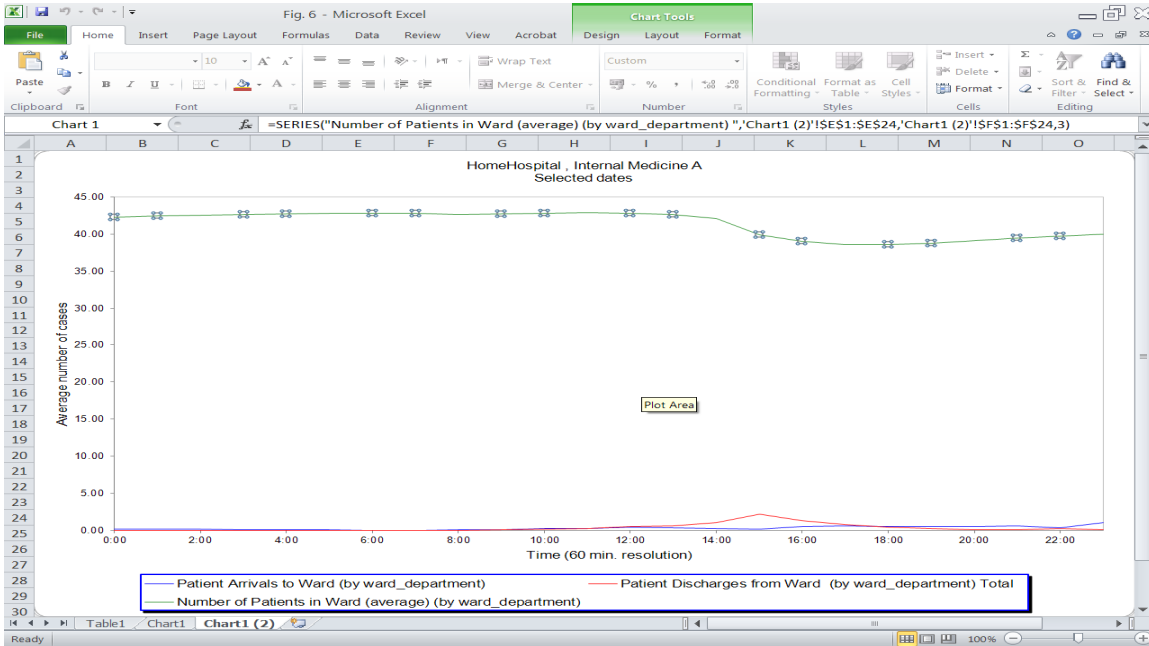


Save file

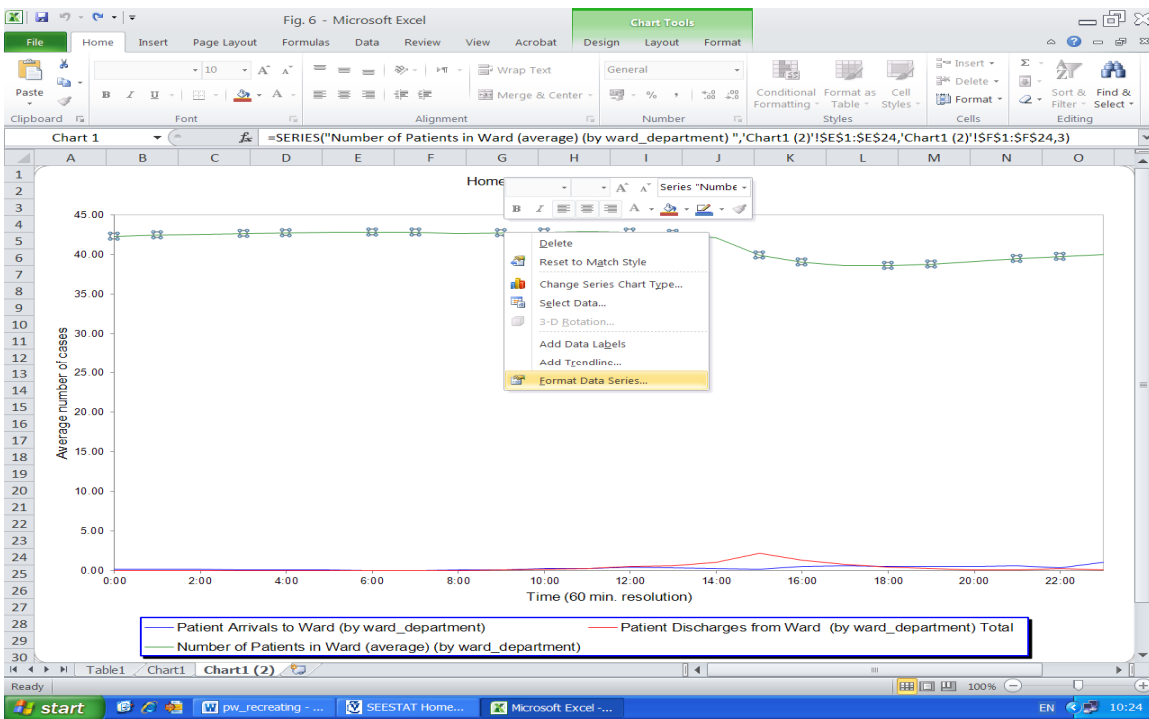


Appendix 5: How to add a secondary vertical axis in Excel

1. Add a secondary vertical axis in the chart: right click on data series “Number of Patients in Ward (average) (by ward_department)” (green line)

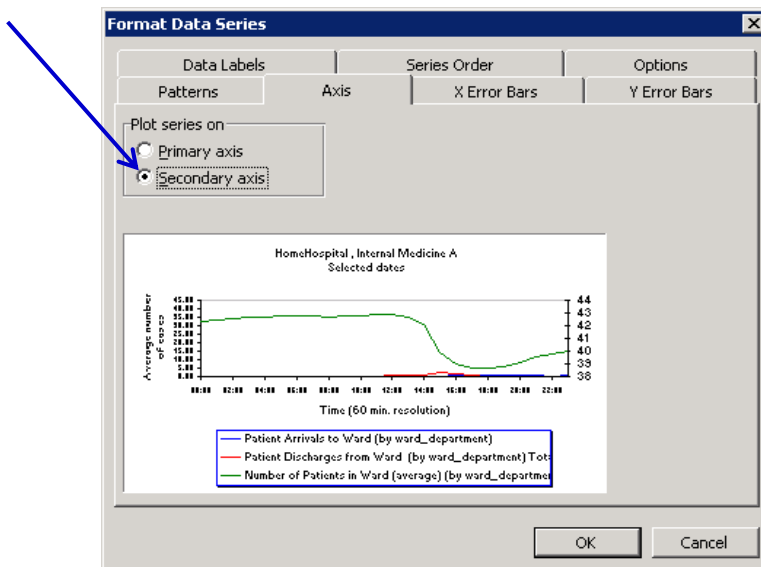


2. Select **Format Data Series...**

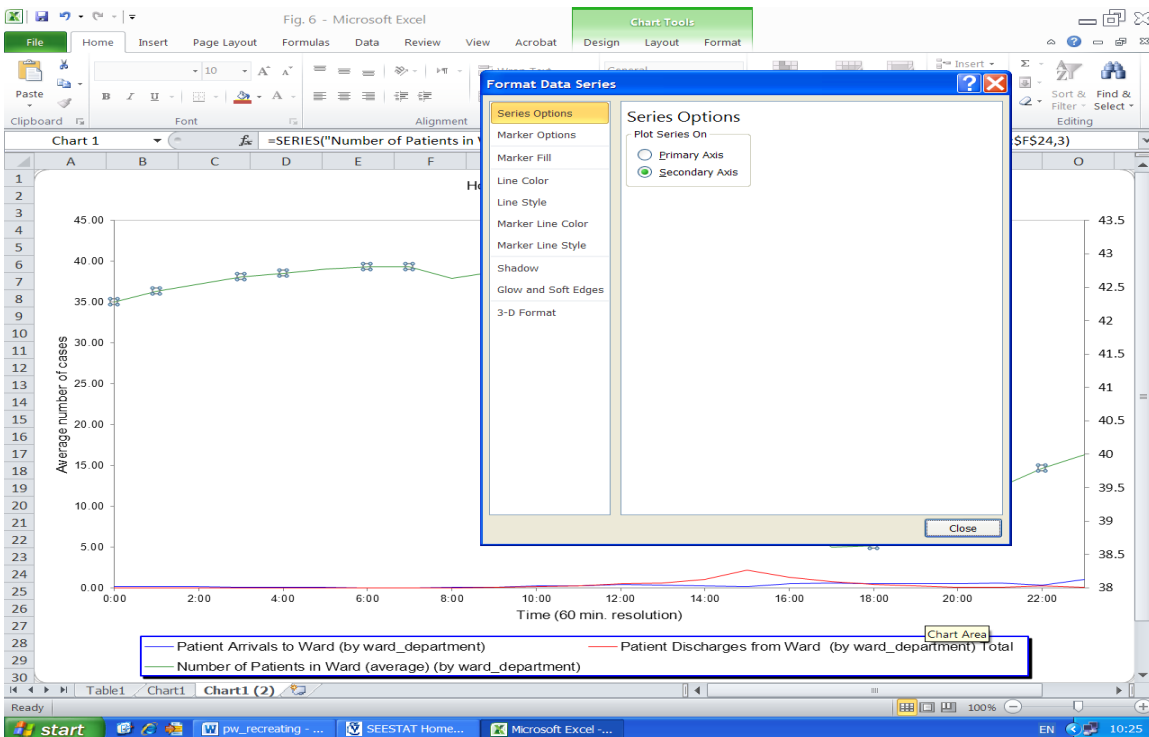


3. Select Secondary Axis

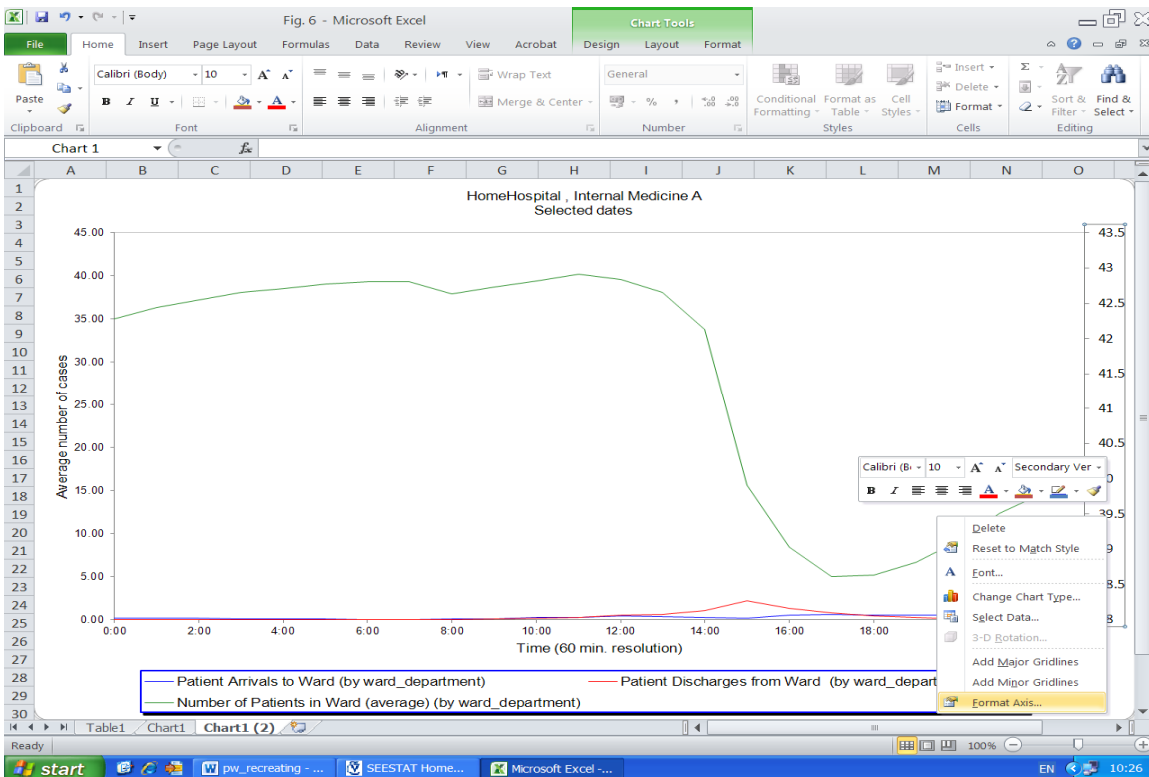
Excel 2003: Click on **Axis** tab and select plot series on **Secondary axis**.



Excel 2010: in **Series Options** select **Secondary Axis**.



4. Right click on secondary axis and select **Format Axis ...**



5. Fill in axis options minimum **36**, maximum **43.5** major unit **1**
Excel 2003: click on tab **Scale** and fill in parameters.

Format Axis

Patterns Scale Font Number Alignment

Value (Y) axis scale

Auto

☐ Minimum: 36

☒ Maximum: 43.5

☐ Major unit: 1

☒ Minor unit: 0.1

☒ Value (X) axis
Crosses at: 38

Display units: None ☒ Show display units label on chart

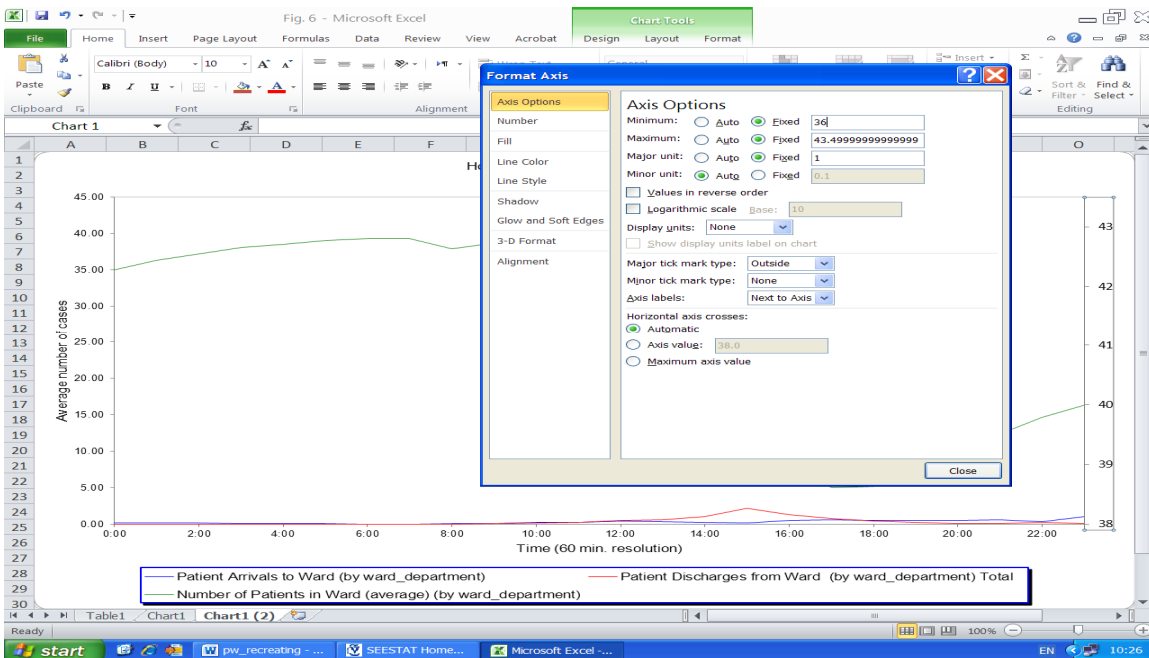
☐ Logarithmic scale

☐ Values in reverse order

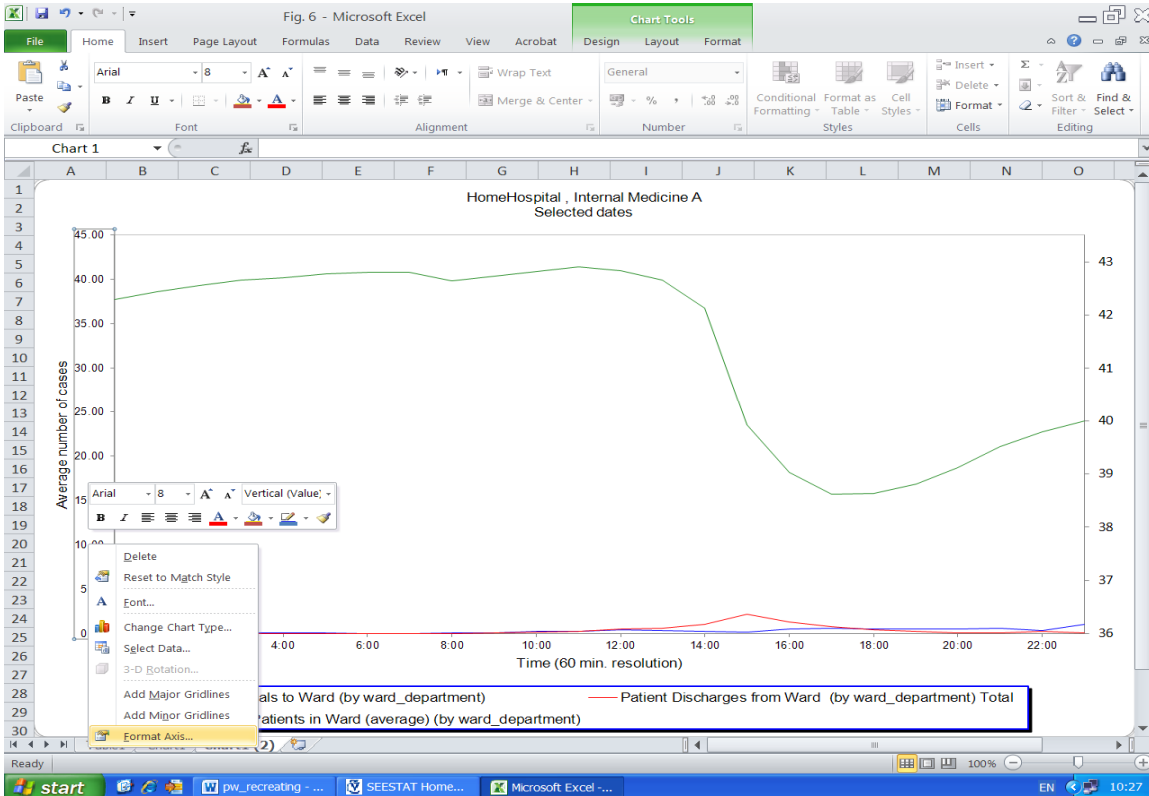
☐ Value (X) axis crosses at maximum value

OK Cancel

Excel 2010: select **Axis Options** and fill in parameters.

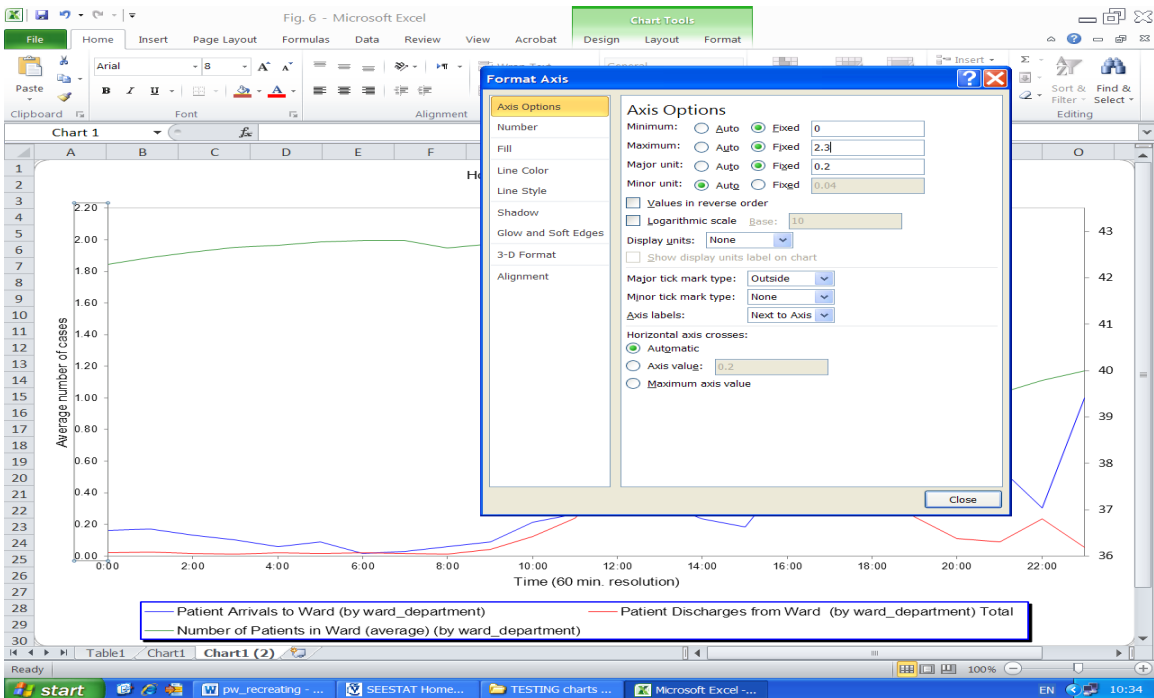


6. Right click on primary axis (left side) and select **Format Axis ...**



7. Fill in axis options minimum 0, maximum 2.3 major unit 0.2

Excel 2003: click on tab **Scale** and fill in parameters.
 Excel 2010: select **Axis Options** and fill in parameters.

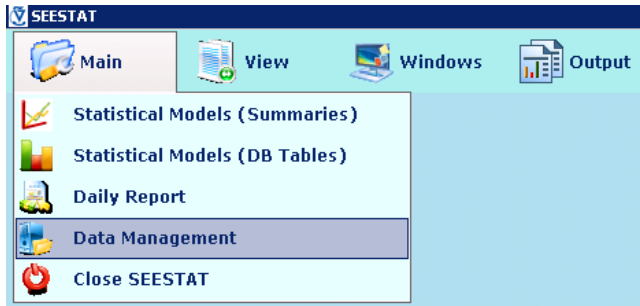


Appendix 6: Creation of SEESTat user extension

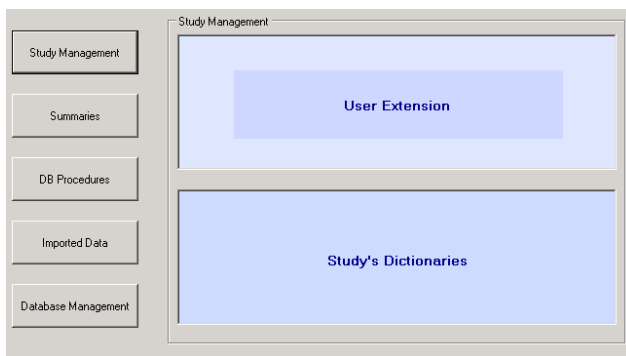
Do it only one time and then it is not necessary to repeat. Note: user space in SEE Server is limited to 150MB.

6.1 Register user folder

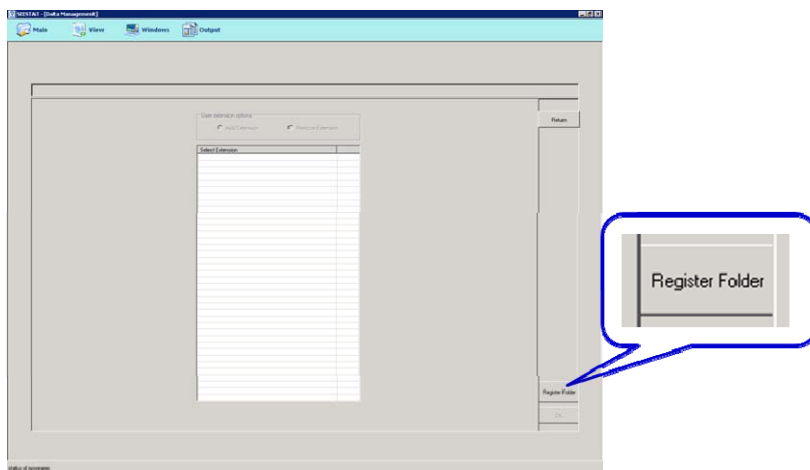
Click Main → Data Management



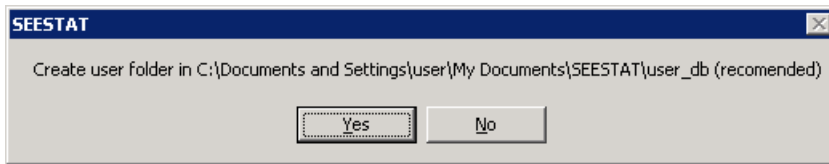
Click Study Management → User Extension



Click Register Folder

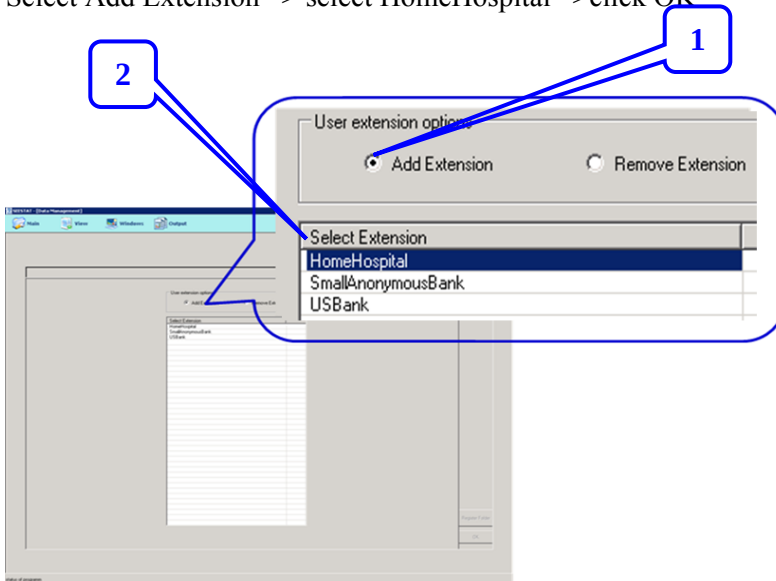


Click Yes



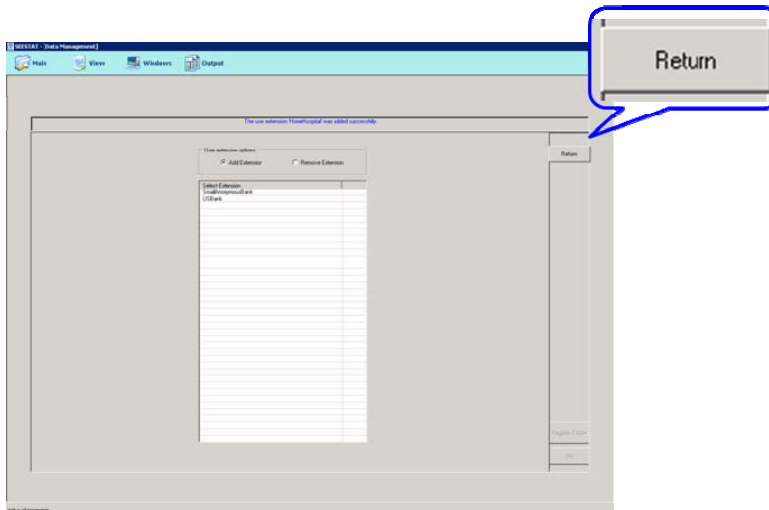
6.2 Add user extension

Select Add Extension → select HomeHospital → click OK



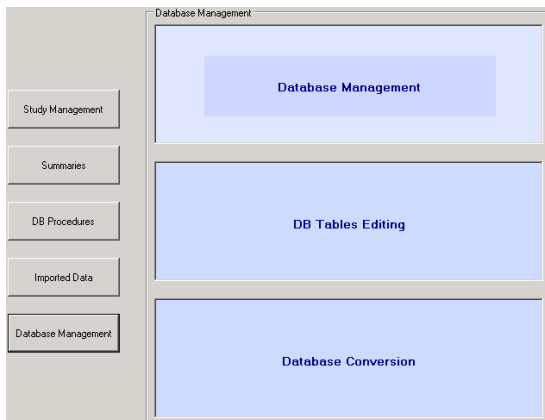
If the message: “*Unable to add or rename extension of the open study HomeHospital*” appeared, reopen SEESTat. Click Main → Data Management → Study Management → User Extension. Select Add Extension → select HomeHospital → click OK

If the above message did not appear, continue with next step:
Click Return

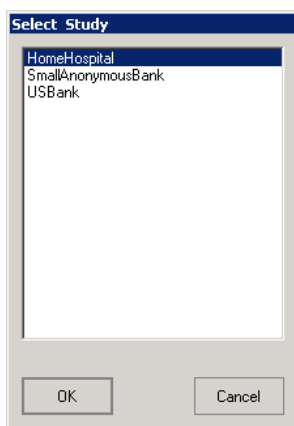


6.3 Create user database

Select Database Management → Database Management

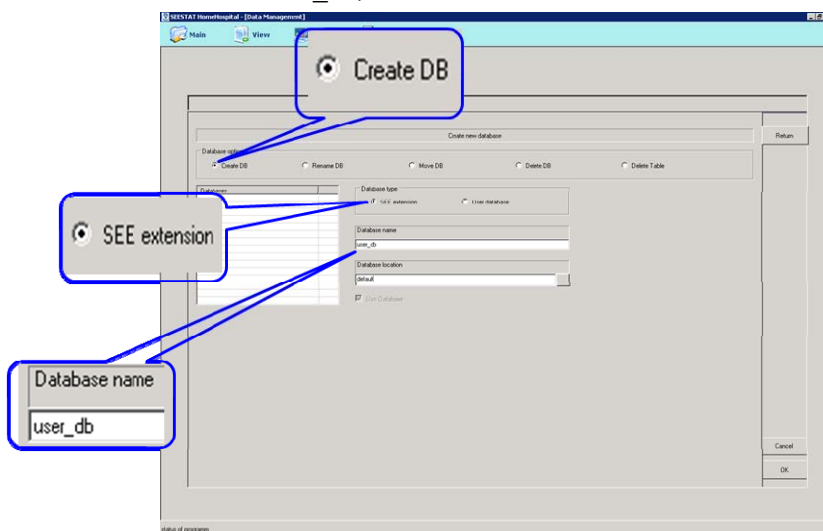


Select HomeHospital study and OK.



From database options select Create DB (radio-button), select database type SEE extension (radio-button),

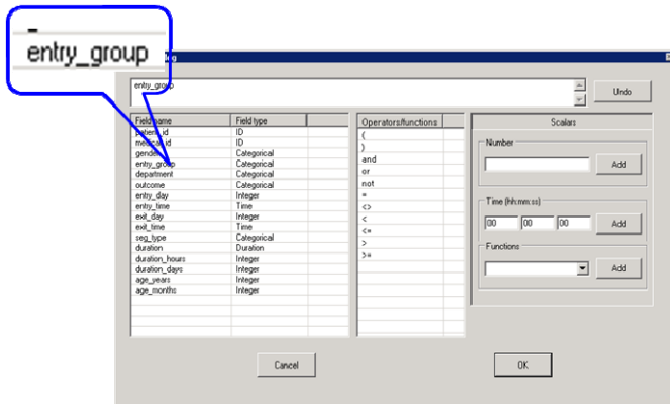
Fill in database name user_db, click OK



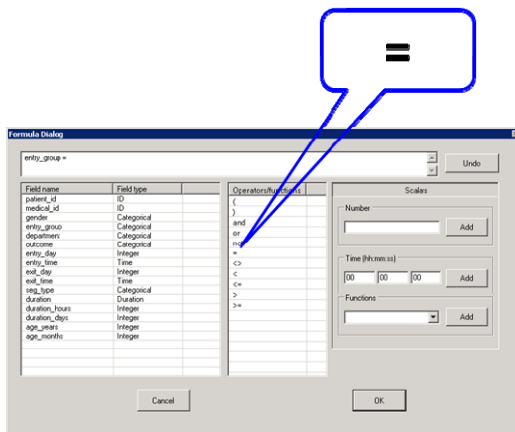
Appendix 7: How to type formula in SEEStat

7.1 Fill in formula: $entry_group = 1$

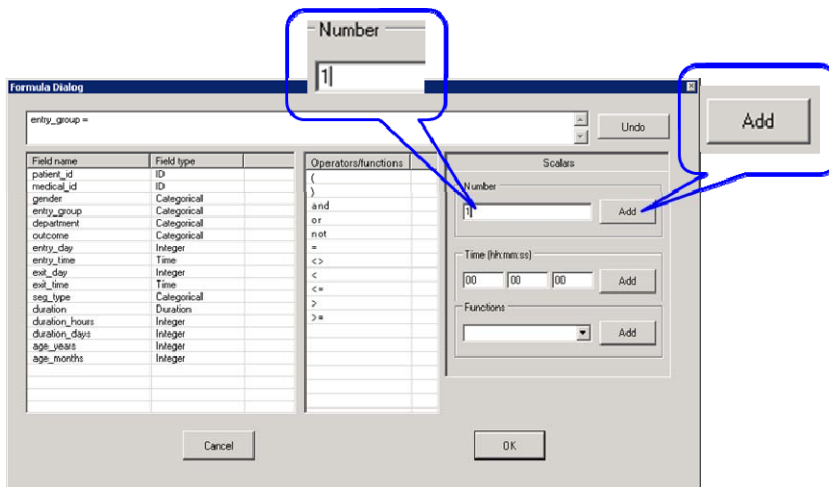
Select `entry_group` field in Field name list box.



Click on operator *equal* (=) in Operators/functions list box.



Write number 1 in text box in frame *Scalars* and click button [Add](#).



Formula Dialog

entry_group = 1 and duration_days < 30 and (department = 1 or department = 2)

Undo

Field name	Field type
patient_id	ID
medical_id	ID
gender	Categorical
entry_group	Categorical
department	Categorical
outcome	Categorical
entry_day	Integer
entry_time	Time
exit_day	Integer
exit_time	Time
seq_type	Categorical
duration	Duration
duration_hours	Integer
duration_days	Integer
age_years	Integer
age_months	Integer

Operators/functions
(
)
and
or
not
=
<>
<
<=
>
>=

Scalars

Number

Time (hh:mm:ss)

00 00 00 Add

Functions

Add

Cancel OK

7.2 Fill in formula: *entry_time* > 09:30:00

Select *entry_time* field in Field name list box. Click on operator *more* (>) in Operators/functions list box. Fill in time 09:30:00 in text box in frame *Time (hh:mm:ss)* and click button [Add](#).

Formula Dialog

entry_time >

Undo

Field name	Field type
patient_id	ID
medical_id	ID
gender	Categorical
entry_group	Categorical
department	Categorical
outcome	Categorical
entry_day	Integer
entry_time	Time
exit_day	Integer
exit_time	Time
seq_type	Categorical
duration	Duration
duration_hours	Integer
duration_days	Integer
age_years	Integer
age_months	Integer

Operators/functions
(
)
and
or
not
=
<>
<
<=
>
>=

Scalars

Number

Time (hh:mm:ss)

09 30 00 Add

Functions

Add

Cancel OK

7.3 Fill in formula: *log* (*duration*)

Select *log* in combo box in frame *Functions* and click button [Add](#).

Formula Dialog

Undo

Field name	Field type
patient_id	ID
medical_id	ID
gender	Categorical
entry_group	Categorical
department	Categorical
outcome	Categorical
entry_day	Integer
entry_time	Time
exit_day	Integer
exit_time	Time
seq_type	Categorical
duration	Duration
duration_hours	Integer
duration_days	Integer
age_years	Integer
age_months	Integer

Operators/functions
(
)
and
or
not
=
<>
<
<=
>
>=

Scalars

Number

Time (hh:mm:ss)

00 00 00 Add

Functions

log
exp
log

Add

Cancel OK

Click on operator *left bracket* (*(*) in Operators/functions list box. Select *duration* field in Field name list box and click on operator *right bracket* (*)*)