Estimating and Prediction of Turn around Time for Incidents in Application Service Maintenance Projects

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Abstract—**Application Service Maintenance Projects normally deals with Incidents as First Level support function. Incidents in majority directly link with Production Environment, so Turn around Time for Incidents is a significant factor. Many Companies are having Service Level Agreements with Customer for Turn around Time for Incidents. There is a need to focus on Estimating and Predicting Turn around Time for Incidents. Improvement in Turn around Time helps in improving the Service Level Agreements earlier agreed with the Customer. Saved time can be diverted to other Project Activities like Enhancements or for new requests. This will also helps as one of the paths for Companies to get new business with the Customer.**
We have used Capability Maturity Model Integration(CMMI)V1.2 Quantitative Project Management(QPM) methodology for Application Service Maintenance(ASM) Projects for estimating and predicting turn around time for incidents. By implementing this best practice in SEI CMMI Level 5 Company we have achieved a significant improvement of approximately 50 percent reduction in Average Turn around Time for incidents.

Index Terms—**Software Estimation, Statistical Process Control, Application Service Maintenance Projects, Incidents**

I. INTRODUCTION

Application Service Maintenance Projects generally deal with First Level, Second Level and Third Level support functions. Normally, First Level support deals with On-Call support for handling Incidents, Second Level support for handling Problems and Third Level support for handling Enhancements or Change requests.

Classification of the support functions may slightly differ from one organization to another organization and also across the ASM projects within the single organization[1].

First level support function Incident has been defined as per IT Infrastructure Library(ITIL) "Any event which is not part of the standard operation of a service and which causes, or may cause, an interruption to, or a reduction in, the quality of that service"[2]. Many Organizations which are dealing with ASM projects adopt Service Desk for handling Incidents.

In the intention of maintaining security and confidentiality of data, authors are constrained not to disclose the company or client name or project name or exact named data in their research. In this context Company name "Excellent", Project name "Super" and client name "Ideal" refer some dummy names. Authors intended to use the past data of SEI CMMI Level 5 matured company "Excellent". It's Project "Super" which is executed earlier for similar type projects data for client "Ideal" is used to estimate and predicting turn around time for Incidents. Incidents are also treated as tickets in "Super" project.

We have used SEI CMMI Level 5 Multinational Company "Excellent" Company's data for our analysis Purpose.

Excellent Company is a worldwide provider of information technology services and business solutions. Excellent Company has adopted industry models for quality service deliveries.

Statement of the Problem : Estimating and Predicting of Turn around Time for Incidents in ASM Projects.

Literature Review : We have undertaken literature review to study work done till now by others with respect to the statement of the problem mentioned above. The literature on Maintenance Estimation is very sparse compared to development estimation. Indeed, any kind of literature on software maintenance is sparse compared to the equivalent literature on software development [1].

Scope of this work : We have focused only on Estimating and Predicting Turn around Time for Incidents. Problems and Enhancements are not in the scope of this research work.

How this is useful to Software community? Software community can be benefited by using this approach in their ASM Project for improving agreed SLAs for incidents for Turn around Time and to get new enhancements and business.

II. METTHODLOGY OF THE WORK

A. Process Performance Model

Capability Maturity Model Integration(CMMI)V1.2 defines Quantitative Process Management(QPM) as one

of its Process Areas. QPM serves in managing the project's defined process quantitatively to achieve the project's established quality and process-performance objectives[5][6]. The purpose of the Quantitative Project Management process area is to quantitatively manage the project's defined process to achieve the project's established quality and process-performance objectives. We can predict process's behavior, if the process is stable, or under control. Statistical methods help in evaluating whether a process is under control or not. Control charts are used to calculate upper control limits (UCL) and lower control limits(LCL). If a process stays within limits we can assume that it is a controlled process. We can use its past performance to predict its future performance within these limits and can determine its capability relative to a customer specification[5][6].

A control chart is a statistical tool used to distinguish between variation in a process due to common causes and variation due to special causes. Main significance of using a using a Control Chart is to achieve and maintain process stability. Process stability is a state in which a process has displayed a certain degree of consistency in the past and is expected to continue to do in the future. This consistency is characterized by a stream of data falling within control limits based on plus or minus 3 standard deviations (3 sigma) of the centerline.

B. Individuals and Moving Range Chart-XmR

Statistical techniques are used as tools of Statistical Process Control(SPC) in QPM for measuring and analyzing the variation in processes[9][10][11]. Control charts are used as main tools in SPC which helps in deciding whether change in process has resulted in improved outcomes. "Individuals and Moving Range Chart"(XmR) is a six sigma tool depends on the consecutive differences in observed values. XmR chart works on one observation per time period and observations are independent of each other[3][7][8].
Average Moving Range = Σ Absolute[[At - At-1]] / (n-1)
Where n is Number of Observations
       At is Observation at time "t"
       At-1 is Observation at time "t-1"
UCL(Upper Control limit) = Average of observations + E * Average of moving range
LCL(Lower Control limi) = Average of observations - E * Average of moving range
"E" is a correction constant which depends on Number of Time Periods[8]
Control charts are helpful in analyzing the data to determine if variation is due to common causes or to special causes. Each process has a variation. Some variation may be the result of causes which are not normally present in the common process behavior. This could be special cause variation. Some variation is simply the result of numerous, ever-present differences in the process. This is common cause variation. Control Charts identifies difference between these two types of variation[3][7][8].

Importance of using a Control Chart is to achieve and maintain process stability. Process stability is defined as a state in which a process has displayed certain degree of consistency in the past and is expected to behave similarly in future. This consistency is identified by a stream of data falling within control limits depending on plus or minus 3 standard deviations (3 sigma) of the center line.

III. RESEARCH WORK DONE

A. Service Level Agreements

"Super" ASM project is a long term engaged project with the customer which is having strict SLAs as shown in below Table1.

Table 1
SLAs For Incidents– "Super" Project

Incidents Severity	Response time	Turn around time
Severity 1	1 Hour	4 Hour
Severity 2	4 Hour	8 Hour
Severity 3	8 Hour	16 Hour
Severity 4	16 Hour	24 Hour

The focus of this paper is arriving baseline values for Turn around Time for Severity 1 Incidents and to monitor statistically Turn around Time for a next period of time. This helps to know whether we are achieving improvement in agreed SLAs for Severity 1 Incidents. "Super" project may revise the SLAs with the customer once they improve the SLAs internally by setting the internal projects goals like to come out with baseline values for turn around time. In next sections of the paper wherever Incidents are discussed readers are requested to assume those are Severity 1 Incidents.

B. Arriving Baseline Values for Turn around Time

We have taken nine months data of Incidents from "Super" project for analysis purpose. Pls. refer Table A1. M1,M2,M3….M9 represent month names. Start time represents at what time programmer starts working on incidents to fix. End time represents at what time Programmer fixes the Incident. Turn around time is the resolution time which has been calculated by End time minus Start time. Reducing Turn around time for incidents is one of the factor which influences in improving the productivity and earlier defined SLAs.
mR is the Moving Range calculated by successive difference between the Turn around time.
Ex: For Month M1, 80 mR value for Incidents id 6 has been arrived by subtracting absolute value of Turn around time of Incident Id 5 & Incident Id 6 and similarly follows for other Incidents Ids.
X bar has been calculated by Average of Turn around time starting from Incident Id 1 to Incident Id 268.
mR bar = Sum of mR for Incident Ids(1.. 268) / Count of number of data point rows -1 = 37.92 Minutes.
Below Table 2 shows formulae for Sigma UCLs and Sigma LCLs Calculations,

Table 2
Sigma UCL and LCL Calculations

3 Sigma UCL(Upper control limit)	X bar + 2.66 * mR bar
3 Sigma LCL(Lower control limit)	X bar - 2.66 * mR bar
2 Sigma UCL	X bar + (2*(2.66)*mR bar)/3
2 Sigma LCL	X bar - (2*(2.66)*mR bar)/3
1 Sigma UCL	X bar + ((2.66)*mR)/3
1 Sigma LCL	X bar - ((2.66)*mR)/3
mR bar UCL	3.268* mR

All UCLs and LCLs for Turn around time have been calculated by using the values from Table 2 and values are listed in below Table 3.

Table 3
Arrived LCL & UCL Values for Turn around Time

3 Sigma UCL	153.50 Minutes
3 Sigma LCL	0 Minutes
2 Sigma UCL	119.87 Minutes
2 Sigma LCL	0 Minutes
1 Sigma UCL	86.24 Minutes
1 Sigma LCL	18.98 Minutes
mR bar UCL	124 Minutes

Incidents data collected for nine months with arrived UCL and LCL values are shown in Table A1 under Appendix. Chart for Individual 'X" has been drawn by using the data from Table A1 as shown in below Fig. 1.

By referring Fig. 1 we came to know that Incident ids 139,142,152,154,156 are outside of 3 sigma level. We have removed these points as shown in Table A2 to for arriving new set of baseline values for UCLs and LCLs.

By referring Fig. 1 we came to know that Incident ids 3, 129,131, 141,143, 209, 237 and 265 are outside of 3 sigma levels. We have removed these points to arrive new set of baseline values for UCLs and LCLs.

X bar value has been arrived to 45 Minutes compared to earlier value of 53 Minutes. Out of Control data points(Incident Ids 3, 129,131, 141,143, 209, 237 and 265) have been removed since this has been identified as a special cause. This is essential to achieve process stability. We can delete data points affected by special causes and use the remaining data to compute new control limits to arrive baseline values. Same has been shown in below Table 4.

Table 4
Arrived LCL, UCL , X Bar Values for Turn Around Time

3 Sigma UCL	112.88 Minutes
3 Sigma LCL	0 Minutes
2 Sigma UCL	90.25 Minutes
2 Sigma LCL	0 Minutes
1 Sigma UCL	67.63 Minutes
1 Sigma LCL	22.37 Minutes
mr bar UCL	83.39 Minutes
X bar	45 Minutes
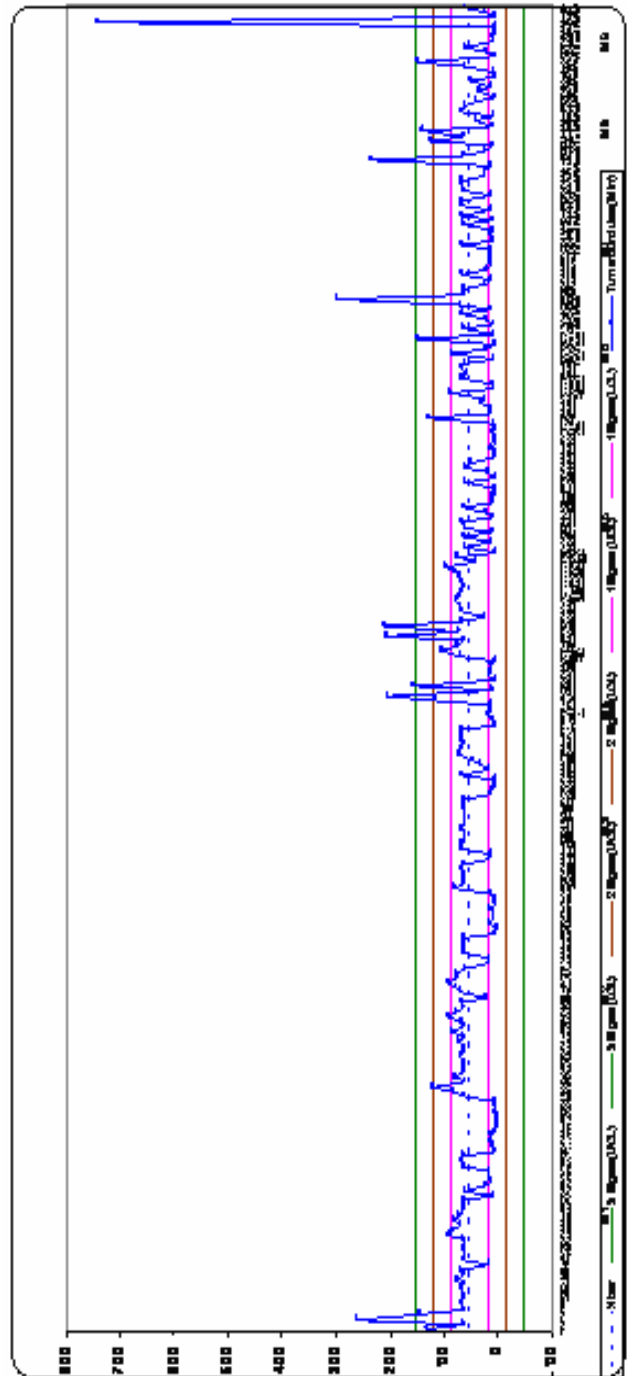
Figure 1. Chart for Individual 'X '

We have analyzed the next set of Incidents data for the next subsequent Month M10 shown in Table A3 under Appendix .

Pls refer below Fig. 2 Chart for Individual X which uses the data from Table A3 for Month M10.

By referring Fig. 2 we came to know that during the Month M10, Incident IDs 269, 280 and 289 lies outside 3 sigma control limit. We have conducted root cause analysis for these incidents & came to know that this is due to the root cause "Understanding of Specifications". Corrective action has been taken to the team members by arranging training and proper domain specific Knowledge transfer.
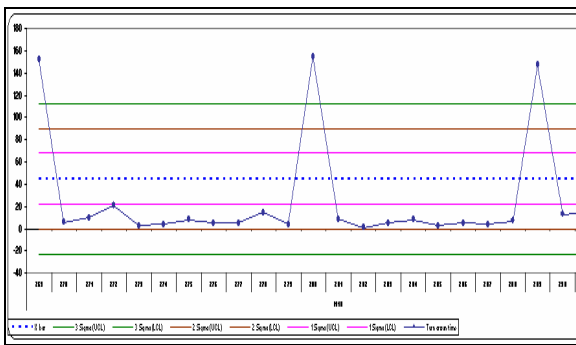
Figure 2 . Chart for Individual 'X ' for M10

C. *Quantitative Improvement Results*

We have followed the QPM methodology for next set of Month M11,M12, M13,M14, M15 and M16 as shown in Tables Table A4, Table A5, Table A6, Table A7, Table A8 and Table A9.

Table 5 shows month wise incidents details as mentioned below:

- Month Name
- Total Number of Incidents resolved
- Total turn around time
- Average turn around time.
- Number Incidents outside 3 Sigma UCL

Table 5
Consolidated Incidents data

Months	Total Number of Incidents	Total Around Time(in mins)	Total Turn Around Time(HH. MM)	Average Turn Around Time in Mins	Number Incidents outside 3 Sigma UCL
M1	47	2531	42.11	54	1
M2	42	2287	38.07	54	0
M3	26	1298	21.38	50	0
M4	21	1055	17.35	50	2
M5	55	2721	45.21	49	2
M6	14	633	10.33	45	0
M7	28	1356	22.36	48	1
M8	20	1053	17.33	53	1
M9	15	1165	19.25	78	1
M10	25	623	10.23	25	3
M11	14	329	5.29	24	0
M12	24	438	7.18	18	0
M13	59	923	15.23	16	1
M14	15	183	3.03	12	0
M15	7	60	1.00	9	0
M16	13	195	3.15	15	0

Fig. 3 below shows Improvement in Average turn around time for Incidents
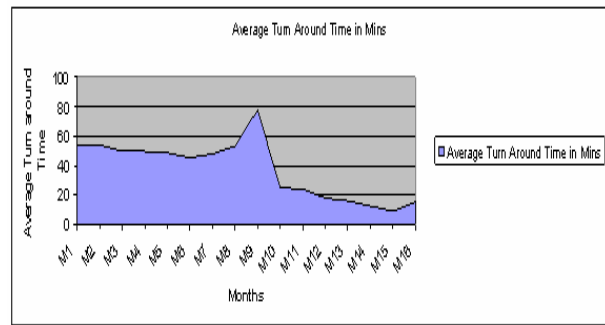
Figure 3. Improvement in Average Turn around Time for Incidents

Below Fig 4 shows the decreasing trend of Out of control points which clearly distinguish between the Months range M1 to M9 to M10 to M16.
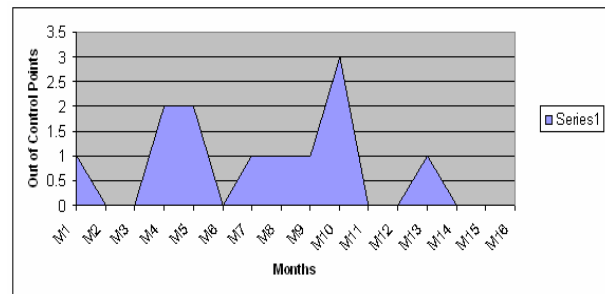
Figure 4. Out of control Points – Decreasing trend[M1 to M9 to M16]

D. *Average Turn Around Time Validation*

By observing Table 6 & Table 7, we infer that for the Months M1 to M9 we have obtained Average turn around time as 53 Minutes and 8 incidents are out side 3 sigma control limits. We have arrived the baseline values for Average Turn around time as 45 Minutes by removing the out of control points, since those points are due to special causes by our root cause analysis. By implementing proposed methodology for next set of months M10 to M16, we have got 25 Mins, 24 Mins, 18 Mins , 16 Mins, 12 Mins, 9 Mins and 15 Mins respectively as shown in Table 6. We have achieved the significant consistent improvement in average turn around time for Months M10 to M16 as shown in last row of Table 7. This implies that we have achieved 50 to 60 percent less than the Average turn around with respect to Months M1 and M9. Also Out of control points are significantly reduced in Months M10 to M16 as shown in above Fig 4 by proposed methodology.

IV. CONCLUSION

Incidents are most vital since, in many cases it affects production operation environment. Estimating and prediction of Turn around time for incidents in ASM Projects help project managers to plan and allocate his team members to different project activities by seeing the trend of incidents in subsequent periods. From our research, it is found that up to 50 % (approx) reduction in average turn around time is possible. This also helps in improving of agreed Service Level Agreements (SLAs)

with the customer which helps in getting new project contracts or Enhancements in long term engaged ASM model.

XmR chart can be used to arrive baseline values for turn around time to set the control limits. This helps in monitoring the project using statistical process control by Quantitative Project Management. Similar analysis can be extended to Level-2[4], Level-3[4] and etc., Support functions of ASM Project.

Saved time may divert in Enhancements activities. This helps to project managers to plan and allocate his team members to different project activities depending on estimating and predicting the turn around time by seeing the trend of incidents in subsequent periods. This also contributes to improving of agreed Service Level Agreements (SLAs) with the customer which helps in getting new project contracts in long term engaged ASM model. Six sigma tool "Individuals and Moving Range Chart"(XmR) has been used as Statistical Process Control(SPC) to arrive baseline values and for calculating Control limits for turn around time. We have used the baseline values to analyze next set of data points to address variations of causes with root cause analysis.

Table 6
Average Turn around Time Validation

Months	Total Number of Incidents	Total Around Time (in mins)	Total Turn Around Time(HH.MM)	Average Turn Around Time in Mins	Number Incidents outside 3 Sigma UCL
M1 to M9	268	14099	234.59	53	8
M1 to M9 after removing out of control points	260	11787	196.27	45(Baseline Value)	
IMPLEMENTATION					
M10	25	623	10.23	25	3
M11	14	329	5.29	24	0
M12	24	438	7.18	18	0
M13	59	923	15.23	16	1
M14	15	183	3.03	12	0
M15	7	60	1.00	9	0
M16	13	195	3.15	15	0

Table 7
Consistent Improvement Average Turn around Time

	Initial Value of average Turn around time before proposed approach(M1 to M9)						
	53 Mins(mm)						
	Baseline Value of average Turn around time by proposing the approcah(M1 to M9)						
	45 Mins						
	M10 implementation (mm)	M11 implementation(mm)	M12 implementation(mm)	M13 implementation(mm)	M14 implementation(mm)	M15 implementation(mm)	M16 implementation(mm)
Average Turn Around time achived after implementing proposed approach	25	24	18	16	12	9	15
Consistent Improvement(53-Average Turn around time acheved)	28	29	35	37	41	44	38

V. DISCUSSION

By observing Table 6 and Table 7, we infer that for Months M1 to M9 we obtained Average turn around time as 53 Minutes. We have arrived the baseline values for Average Turn around time as 45 Minutes by analysis. Further we have arrived the baseline values for UCL and LCL values for turn around time by monitoring and controlling the processes statistically. We have obtained 25 Mins, 24 Mins, 18 Mins , 16 Mins, 12 Mins, 9 Mins and 15 Mins for subsequent Months M10,M11,M12,M13,M14,M15 and M16. respectively by analyzing, monitoring and controlling the data by QPM methodology. We have achieved the significant improvement in average turn around time for Months M10 to M16 which is 50 to 60 percent less than the Average turn around with respect to Months M1 to M9 as shown in Fig 3.

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APPENDIX

Table A1
Incidents Data Sheet for XmR chart – M1 to M9

Month	Incidents / Tickets Ids	Start time (hh.mm)	End Time (hh.mm)	Turn around time(Min)	mR
M1	1	2.00	4.12	132	
	2	2.37	3.42	65	67
	3	5.30	9.52	262	197
	4	1.50	4.15	145	117
	5	2.37	3.42	65	80
	6	2.40	3.47	67	2
	7	1.54	2.59	65	2
	8	2.50	3.55	65	0
	9	5.50	6.56	66	1
	10	2.40	3.45	65	1
	11	5.10	6.25	75	10
	12	3.20	4.25	65	10
	13	3.50	5.00	70	5
	14	4.30	4.45	15	55
	15	5.45	6.50	65	50
	16	1.34	2.36	62	3
	17	3.05	4.10	65	3
	18	2.55	3.57	62	3
	19	5.30	6.35	65	3
	20	1.50	3.20	90	25
	21	1.02	2.25	83	7
	22	2.45	3.55	70	13
	23	1.35	2.55	80	10
	24	2.27	3.40	73	7
	25	2.40	3.45	65	8
	26	3.05	4.10	65	0
	27	5.05	6.10	65	0
	28	2.38	2.45	7	58
	29	2.38	3.40	62	55
	30	5.55	6.15	20	42
	31	2.38	2.50	12	8
	32	1.38	1.55	17	5
	33	1.38	1.55	17	0
	34	2.41	3.46	65	48
	35	1.12	2.20	68	3
	36	2.35	3.40	65	3
	37	2.40	2.45	5	60
	38	2.05	2.15	10	5
	39	2.38	2.50	12	2
	40	2.38	2.50	12	0
	41	2.55	2.59	4	8
	42	2.48	2.50	2	2
	43	2.40	2.43	3	1
	44	2.40	2.43	3	0
	45	2.40	2.45	5	2
	46	2.57	3.05	5	0
	47	12.20	12.25	5	0
M2	48	3.40	4.45	65	60
	49	2.00	3.22	82	17
	50	11.30	1.30	120	38
	51	19.22	20.25	62	58
	52	12.29	1.49	80	18
	53	2.59	4.04	65	15
	54	2.40	3.45	65	0
	55	3.04	4.09	65	0
	56	2.55	4.05	70	5
	57	3.25	4.30	65	5
	58	2.37	3.40	62	3
	59	2.45	3.57	72	10
	60	3.25	4.30	65	7
	61	3.10	4.35	85	20
	62	2.48	3.52	64	21
	63	1.45	2.53	68	4
	64	2.00	3.30	90	22
	65	2.45	4.02	77	13
	66	3.50	4.55	65	12
	67	2.44	3.50	66	1
	68	1.30	1.50	20	46
	69	2.40	3.50	70	50
	70	12.38	1.55	77	7
	71	1.34	3.05	91	14
	72	7.00	8.15	75	16
	73	3.00	4.17	77	2
	74	1.28	2.30	62	15
	75	2.45	3.00	15	47
	76	2.45	3.00	15	0
	77	3.05	4.09	64	49
	78	2.41	3.45	64	0
	79	2.56	4.00	64	0
	80	1.55	3.00	65	1
	81	2.15	2.20	5	60
	82	2.44	2.47	3	2
	83	5.10	5.25	15	12
	84	4.18	4.25	7	8
	85	1.08	1.15	7	0
	86	12.40	12.55	15	8
	87	2.34	2.40	6	9
	88	2.36	2.40	4	2
	89	3.02	3.15	13	9

M3	90	2.26	3.46	80	67
	91	2.40	3.45	65	15
	92	2.35	3.40	65	0
	93	2.40	3.45	65	0
	94	4.02	5.10	68	3
	95	2.40	3.45	65	3
	96	2.29	2.46	17	48
	97	1.58	2.12	14	3
	98	3.11	4.20	69	55
	99	1.10	2.16	66	3
	100	2.42	3.45	63	3
	101	3.05	4.08	63	0
	102	2.44	3.50	66	3
	103	4.42	5.45	63	3
	104	2.42	3.45	63	0
	105	2.39	3.41	62	1
	106	2.40	3.45	65	3
	107	4.10	5.15	65	0
	108	4.10	5.15	65	0
	109	10.45	11.00	15	50
	110	3.50	4.00	10	5
	111	3.00	3.05	5	5
	112	2.15	3.20	5	0
	113	2.10	2.17	67	62
	114	12.50	1.05	15	52
	115	11.57	12.29	32	17
M4	116	3.55	4.40	45	13
	117	2.07	3.20	73	28
	118	1.40	2.50	70	3
	119	2.40	3.45	65	5
	120	1.30	2.40	70	5
	121	1.27	2.35	68	2
	122	2.44	3.50	66	2
	123	2.44	2.50	6	60
	124	2.40	2.50	10	4
	125	12.32	12.51	19	9
	126	2.22	2.35	13	6
	127	12.47	12.59	12	1
	128	7.12	9.07	115	103
	129	10.04	1.29	205	90
	130	10.55	11.05	10	195
	131	6.32	9.08	156	146
	132	10.40	10.46	6	150
	133	7.54	8.11	17	11
	134	3.19	3.31	12	5
	135	3.33	3.45	12	0
	136	4.10	4.15	5	7
M5	137	3.40	4.50	70	65
	138	8.29	10.15	106	36
	139	2.35	3.50	75	31
	140	10.45	11.48	65	10
	141	6.20	9.44	206	141
	142	3.50	5.02	72	134
	143	6.38	10.07	209	137
	144	11.05	12.13	68	141
	145	8.42	11.06	24	44
	146	7.30	8.36	66	42
	147	11.02	12.13	71	5
	148	2.22	3.40	78	7
	149	7.54	9.06	72	6
	150	1.40	2.50	70	2
	151	4.30	5.35	65	5
	152	3.04	4.12	68	3
	153	1.45	2.57	72	4
	154	1.10	2.30	80	8
	155	1.12	2.50	98	18
	156	11.33	12.14	41	57
	157	1.34	2.50	76	35
	158	2.29	2.35	6	70
	159	8.15	9.17	62	56
	160	12.22	12.35	13	49
	161	10.10	11.14	64	51
	162	10.20	10.30	10	54
	163	11.21	12.24	63	53
	164	12.39	1.46	67	4
	165	7.17	7.28	11	56
	166	3.00	3.20	20	9
	167	10.30	11.35	65	45
	168	12.05	12.15	10	55
	169	10.04	10.15	11	1
	170	12.11	12.15	4	7
	171	1.35	1.39	4	0
	172	2.10	3.11	61	57
	173	3.18	3.22	4	57
	174	3.36	3.54	18	14
	175	12.35	1.36	61	43
	176	1.59	2.50	51	10
	177	7.44	7.53	9	42
	178	10.10	10.16	6	3
	179	10.00	10.13	13	7
	180	11.50	11.55	5	8
	181	2.10	2.15	5	0
	182	1.05	1.15	10	5
	183	10.12	10.18	6	4
	184	12.00	12.07	7	1
	185	12.54	3.03	129	122
	186	6.20	6.34	14	115
	187	7.30	7.42	12	2
	188	1.47	2.15	28	16
	189	1.54	2.18	24	4
	190	1.32	3.00	88	64
	191	2.55	3.03	8	80
M6	192	12.40	12.51	11	3
	193	2.44	3.50	66	55
	194	1.30	2.30	60	6
	195	4.44	5.50	66	6
	196	2.42	3.45	63	3
	197	3.41	3.50	9	54
	198	1.00	2.25	85	76
	199	1.30	1.50	20	65
	200	5.57	6.03	6	14
	201	11.32	2.01	149	143
	202	1.00	1.07	7	142
	203	2.46	3.50	64	57
	204	8.33	8.40	7	57
	205	10.05	10.25	20	13

M7	206	3.15	4.22	67	47
	207	2.50	3.04	14	53
	208	3.30	4.40	70	56
	209	5.45	10.43	298	228
	210	5.58	7.03	65	233
	211	2.36	3.40	64	1
	212	23.33	23.58	25	39
	213	23.30	23.42	12	13
	214	12.57	2.05	68	56
	215	1.10	1.30	20	48
	216	3.10	3.22	12	8
	217	12.34	12.47	13	1
	218	12.31	12.46	15	2
	219	12.50	1.02	12	3
	220	2.15	3.22	67	55
	221	12.22	12.32	10	57
	222	2.19	2.32	13	3
	223	20.40	20.51	11	2
	224	3.16	4.21	65	54
	225	12.25	12.35	10	55
	226	12.27	1.35	68	58
	227	12.25	12.38	13	55
	228	12.33	1.39	66	53
	229	20.12	21.18	66	0
	230	12.10	12.22	12	54
	231	2.55	4.00	65	53
	232	12.19	1.26	67	2
	233	12.17	1.25	68	1
M8	234	2.55	3.18	23	45
	235	2.55	3.20	25	2
	236	2.55	3.07	12	13
	237	5.05	9.00	235	223
	238	5.40	6.45	65	170
	239	1.17	1.40	23	42
	240	1.50	2.00	10	13
	241	1.27	3.30	123	113
	242	2.48	3.53	65	58
	243	1.13	3.33	140	75
	244	12.40	12.50	10	130
	245	12.56	1.37	41	31
	246	2.56	3.05	9	32
	247	2.47	3.53	66	57
	248	12.29	1.32	63	3
	249	23.40	0.20	40	23
	250	10.12	10.18	6	34
	251	1.18	1.53	35	29
	252	2.50	3.02	12	23
	253	1.50	2.40	50	38
M9	254	1.20	1.25	5	45
	255	1.37	1.45	8	3
	256	1.54	2.57	63	55
	257	2.56	5.23	147	84
	258	2.20	2.25	5	142
	259	23.25	23.45	20	15
	260	4.05	5.10	62	42
	261	12.25	12.32	7	55
	262	2.35	2.45	10	3
	263	2.14	2.19	5	5
	264	2.35	2.39	4	1
	265	14.10	2.31	741	737
	266	2.51	2.55	4	737
	267	1.30	1.53	23	19
	268	2.54	3.55	61	38

Table A2
Incidents data – After removing out-of –control points

M1	1	2.00	4.12	132	
	2	2.37	3.42	65	67
	4	1.50	4.15	145	80
	5	2.37	3.42	65	80
	6	2.40	3.47	67	2
	7	1.54	2.59	65	2
	8	2.50	3.55	65	0
	9	5.50	6.56	66	1
	10	2.40	3.45	65	1
	11	5.10	6.25	75	10
	12	3.20	4.25	65	10
	13	3.50	5.00	70	5
	14	4.30	4.45	15	55
	15	5.45	6.50	65	50
	16	1.34	2.36	62	3
	17	3.05	4.10	65	3
	18	2.55	3.57	62	3
	19	5.30	6.35	65	3
	20	1.50	3.20	90	25
	21	1.02	2.25	83	7
	22	2.45	3.55	70	13
	23	1.35	2.55	80	10
	24	2.27	3.40	73	7
	25	2.40	3.45	65	8
	26	3.05	4.10	65	0
	27	5.05	6.10	65	0
	28	2.38	2.45	7	58
	29	2.38	3.40	62	55
	30	5.55	6.15	20	42
	31	2.38	2.50	12	8
	32	1.38	1.55	17	5
	33	1.38	1.55	17	0
	34	2.41	3.46	65	48
	35	1.12	2.20	68	3
	36	2.35	3.40	65	3
	37	2.40	2.45	5	60
	38	2.05	2.15	10	5
	39	2.38	2.50	12	2
	40	2.38	2.50	12	0
	41	2.55	2.59	4	8
	42	2.48	2.50	2	2
	43	2.40	2.43	3	1
	44	2.40	2.43	3	0
	45	2.40	2.45	5	2
	46	2.57	3.05	5	0
	47	12.20	12.25	5	0
M2	48	3.40	4.45	65	60
	49	2.00	3.22	82	17
	50	11.30	1.30	120	38
	51	19.22	20.25	62	58
	52	12.29	1.49	80	18
	53	2.59	4.04	65	15
	54	2.40	3.45	65	0
	55	3.04	4.09	65	0
	56	2.55	4.05	70	5
	57	3.25	4.30	65	5
	58	2.37	3.40	62	3
	59	2.45	3.57	72	10
	60	3.25	4.30	65	7
	61	3.10	4.35	85	20
	62	2.48	3.52	64	21
	63	1.45	2.53	68	4
	64	2.00	3.30	90	22
	65	2.45	4.02	77	13
	66	3.50	4.55	65	12
	67	2.44	3.50	66	1
	68	1.30	1.50	20	46
	69	2.40	3.50	70	50
	70	12.38	1.55	77	7
	71	1.34	3.05	91	14
	72	7.00	8.15	75	16
	73	3.00	4.17	77	2
	74	1.28	2.30	62	15
	75	2.45	3.00	15	47
	76	2.45	3.00	15	0
	77	3.05	4.09	64	49
	78	2.41	3.45	64	0
	79	2.56	4.00	64	0
	80	1.55	3.00	65	1
	81	2.15	2.20	5	60
	82	2.44	2.47	3	2
	83	5.10	5.25	15	12
	84	4.18	4.25	7	8
	85	1.08	1.15	7	0
	86	12.40	12.55	15	8
	87	2.34	2.40	6	9
	88	2.36	2.40	4	2
	89	3.02	3.15	13	9

M3	90	2.26	3.46	80	67
	91	2.40	3.45	65	15
	92	2.35	3.40	65	0
	93	2.40	3.45	65	0
	94	4.02	5.10	68	3
	95	2.40	3.45	65	3
	96	2.29	2.46	17	48
	97	1.58	2.12	14	3
	98	3.11	4.20	69	55
	99	1.10	2.16	66	3
	100	2.42	3.45	63	3
	101	3.05	4.08	63	0
	102	2.44	3.50	66	3
	103	4.42	5.45	63	3
	104	2.42	3.45	63	0
	105	2.39	3.41	62	1
	106	2.40	3.45	65	3
	107	4.10	5.15	65	0
	108	4.10	5.15	65	0
	109	10.45	11.00	15	50
	110	3.50	4.00	10	5
	111	3.00	3.05	5	5
	112	2.15	3.20	5	0
	113	2.10	2.17	67	62
	114	12.50	1.05	15	52
	115	11.57	12.29	32	17
M4	116	3.55	4.40	45	13
	117	2.07	3.20	73	28
	118	1.40	2.50	70	3
	119	2.40	3.45	65	5
	120	1.30	2.40	70	5
	121	1.27	2.35	68	2
	122	2.44	3.50	66	2
	123	2.44	2.50	6	60
	124	2.40	2.50	10	4
	125	12.32	12.51	19	9
	126	2.22	2.35	13	6
	127	12.47	12.59	12	1
	128	7.12	9.07	115	103
	130	10.55	11.05	10	105
	132	10.40	10.46	6	4
	133	7.54	8.11	17	11
	134	3.19	3.31	12	5
	135	3.33	3.45	12	0
	136	4.10	4.15	5	7
M5	137	3.40	4.50	70	65
	138	8.29	10.15	106	36
	139	2.35	3.50	75	31
	140	10.45	11.48	65	10
	142	3.50	5.02	72	7
	144	11.05	12.13	68	4
	145	8.42	11.06	24	44
	146	7.30	8.36	66	42
	147	11.02	12.13	71	5
	148	2.22	3.40	78	7
	149	7.54	9.06	72	6
	150	1.40	2.50	70	2
	151	4.30	5.35	65	5
	152	3.04	4.12	68	3
	153	1.45	2.57	72	4
	154	1.10	2.30	80	8
	155	1.12	2.50	98	18
	156	11.33	12.14	41	57
	157	1.34	2.50	76	35
	158	2.29	2.35	6	70
	159	8.15	9.17	62	56
	160	12.22	12.35	13	49
	161	10.10	11.14	64	51
	162	10.20	10.30	10	54
	163	11.21	12.24	63	53
	164	12.39	1.46	67	4
	165	7.17	7.28	11	56
	166	3.00	3.20	20	9
	167	10.30	11.35	65	45
	168	12.05	12.15	10	55
	169	10.04	10.15	11	1
	170	12.11	12.15	4	7
	171	1.35	1.39	4	0
	172	2.10	3.11	61	57
	173	3.18	3.22	4	57
	174	3.36	3.54	18	14
	175	12.35	1.36	61	43
	176	1.59	2.50	51	10
	177	7.44	7.53	9	42
	178	10.10	10.16	6	3
	179	10.00	10.13	13	7
	180	11.50	11.55	5	8
	181	2.10	2.15	5	0
	182	1.05	1.15	10	5
	183	10.12	10.18	6	4
	184	12.00	12.07	7	1
	185	12.54	3.03	129	122
	186	6.20	6.34	14	115
	187	7.30	7.42	12	2
	188	1.47	2.15	28	16
	189	1.54	2.18	24	4
	190	1.32	3.00	88	64
	191	2.55	3.03	8	80

Month	Incidents/Tickets Ids	Start time	End Time	Turn around time	mR
M6	192	12.40	12.51	11	3
	193	2.44	3.50	66	55
	194	1.30	2.30	60	6
	195	4.44	5.50	66	6
	196	2.42	3.45	63	3
	197	3.41	3.50	9	54
	198	1.00	2.25	85	76
	199	1.30	1.50	20	65
	200	5.57	6.03	6	14
	201	11.32	2.01	149	143
	202	1.00	1.07	7	142
	203	2.46	3.50	64	57
	204	8.33	8.40	7	57
	205	10.05	10.25	20	13
M7	206	3.15	4.22	67	47
	207	2.50	3.04	14	53
	208	3.30	4.40	70	56
	210	5.58	7.03	65	5
	211	2.36	3.40	64	1
	212	23.33	23.58	25	39
	213	23.30	23.42	12	13
	214	12.57	2.05	68	56
	215	1.10	1.30	20	48
	216	3.10	3.22	12	8
	217	12.34	12.47	13	1
	218	12.31	12.46	15	2
	219	12.50	1.02	12	3
	220	2.15	3.22	67	55
	221	12.22	12.32	10	57
	222	2.19	2.32	13	3
	223	20.40	20.51	11	2
	224	3.16	4.21	65	54
	225	12.25	12.35	10	55
	226	12.27	1.35	68	58
	227	12.25	12.38	13	55
	228	12.33	1.39	66	53
	229	20.12	21.18	66	0
	230	12.10	12.22	12	54
	231	2.55	4.00	65	53
	232	12.19	1.26	67	2
	233	12.17	1.25	68	1
M8	234	2.55	3.18	23	45
	235	2.55	3.20	25	2
	236	2.55	3.07	12	13
	238	5.40	6.45	65	53
	239	1.17	1.40	23	42
	240	1.50	2.00	10	13
	241	1.27	3.30	123	113
	242	2.48	3.53	65	58
	243	1.13	3.33	140	75
	244	12.40	12.50	10	130
	245	12.56	1.37	41	31
	246	2.56	3.05	9	32
	247	2.47	3.53	66	57
	248	12.29	1.32	63	3
	249	23.40	0.20	40	23
	250	10.12	10.18	6	34
	251	1.18	1.53	35	29
	252	2.50	3.02	12	23
	253	1.50	2.40	50	38
M9	254	1.20	1.25	5	45
	255	1.37	1.45	8	3
	256	1.54	2.57	63	55
	257	2.56	5.23	147	84
	258	2.20	2.25	5	142
	259	23.25	23.45	20	15
	260	4.05	5.10	62	42
	261	12.25	12.32	7	55
	262	2.35	2.45	10	3
	263	2.14	2.19	5	5
	264	2.35	2.39	4	1
	266	2.51	2.55	4	0
	267	1.30	1.53	23	19
	268	2.54	3.55	61	38

Table A 3
Incidents data for Month M10

Month	Incidents/Tickets Ids	Start time	End Time	Turn aroun time	mR	X bar	mR.bar	3 Sigma (UCL)	3 Sigma (LCL)	2 Sigma (UCL)	2 Sigma (LCL)	1 Sigma (UCL)	1 Sigma (LCL)	mR bar(UCL)
M10	269	3.08	5.40	152		45	34.00	112.88	-22.88	90.25	-0.25	67.63	22.37	111.11
	270	4.34	4.40	6	146	45	34.00	112.88	-22.88	90.25	-0.25	67.63	22.37	111.11
	271	1.09	1.19	10	4	45	34.00	112.88	-22.88	90.25	-0.25	67.63	22.37	111.11
	272	3.03	3.24	21	11	45	34.00	112.88	-22.88	90.25	-0.25	67.63	22.37	111.11
	273	2.42	2.45	3	18	45	34.00	112.88	-22.88	90.25	-0.25	67.63	22.37	111.11
	274	2.19	2.23	4	1	45	34.00	112.88	-22.88	90.25	-0.25	67.63	22.37	111.11
	275	1.36	1.44	8	4	45	34.00	112.88	-22.88	90.25	-0.25	67.63	22.37	111.11
	276	3.25	3.30	5	3	45	34.00	112.88	-22.88	90.25	-0.25	67.63	22.37	111.11
	277	6.00	6.05	5	0	45	34.00	112.88	-22.88	90.25	-0.25	67.63	22.37	111.11
	278	2.00	2.15	15	10	45	34.00	112.88	-22.88	90.25	-0.25	67.63	22.37	111.11
	279	1.54	1.58	4	11	45	34.00	112.88	-22.88	90.25	-0.25	67.63	22.37	111.11
	280	3.15	5.50	155	151	45	34.00	112.88	-22.88	90.25	-0.25	67.63	22.37	111.11
	281	4.50	4.59	9	146	45	34.00	112.88	-22.88	90.25	-0.25	67.63	22.37	111.11
	282	2.09	2.10	1	8	45	34.00	112.88	-22.88	90.25	-0.25	67.63	22.37	111.11
	283	5.00	5.05	5	4	45	34.00	112.88	-22.88	90.25	-0.25	67.63	22.37	111.11
	284	3.50	3.58	8	3	45	34.00	112.88	-22.88	90.25	-0.25	67.63	22.37	111.11
	285	12.05	12.08	3	5	45	34.00	112.88	-22.88	90.25	-0.25	67.63	22.37	111.11
	286	2.48	2.53	5	2	45	34.00	112.88	-22.88	90.25	-0.25	67.63	22.37	111.11
	287	4.47	4.51	4	1	45	34.00	112.88	-22.88	90.25	-0.25	67.63	22.37	111.11
	288	4.52	4.59	7	3	45	34.00	112.88	-22.88	90.25	-0.25	67.63	22.37	111.11
	289	12.48	3.15	147	140	45	34.00	112.88	-22.88	90.25	-0.25	67.63	22.37	111.11
	290	4.49	5.02	13	134	45	34.00	112.88	-22.88	90.25	-0.25	67.63	22.37	111.11
	291	3.17	3.22	15	2	45	34.00	112.88	-22.88	90.25	-0.25	67.63	22.37	111.11
	292	3.28	3.36	8	7	45	34.00	112.88	-22.88	90.25	-0.25	67.63	22.37	111.11
	293	5.30	5.40	10	2	45	34.00	112.88	-22.88	90.25	-0.25	67.63	22.37	111.11

Table A4
Incidents data for Month M11

Month	Incidents/Tickets Ids	Start time	End Time	Turn around time	mR	X bar	mR.bar	3 Sigma (UCL)	3 Sigma (LCL)	2 Sigma (UCL)	2 Sigma (LCL)	1 Sigma (UCL)	1 Sigma (LCL)	mR bar(UCL)
M11	294	1.47	2.03	16		45	27.92	112.88	-22.88	90.25	-0.25	67.63	22.37	91.25
	295	2.05	3.13	78	62	45	27.92	112.88	-22.88	90.25	-0.25	67.63	22.37	91.25
	296	3.04	3.15	11	67	45	27.92	112.88	-22.88	90.25	-0.25	67.63	22.37	91.25
	297	2.40	2.43	3	8	45	27.92	112.88	-22.88	90.25	-0.25	67.63	22.37	91.25
	298	1.51	1.58	7	4	45	27.92	112.88	-22.88	90.25	-0.25	67.63	22.37	91.25
	299	3.05	3.30	25	18	45	27.92	112.88	-22.88	90.25	-0.25	67.63	22.37	91.25
	300	3.05	3.25	20	5	45	27.92	112.88	-22.88	90.25	-0.25	67.63	22.37	91.25
	301	4.28	4.37	9	11	45	27.92	112.88	-22.88	90.25	-0.25	67.63	22.37	91.25
	302	11.22	11.26	4	5	45	27.92	112.88	-22.88	90.25	-0.25	67.63	22.37	91.25
	303	1.08	1.18	10	6	45	27.92	112.88	-22.88	90.25	-0.25	67.63	22.37	91.25
	304	1.59	3.13	74	64	45	27.92	112.88	-22.88	90.25	-0.25	67.63	22.37	91.25
	305	10.45	11.06	21	53	45	27.92	112.88	-22.88	90.25	-0.25	67.63	22.37	91.25
	306	11.11	11.15	4	17	45	27.92	112.88	-22.88	90.25	-0.25	67.63	22.37	91.25
	307	1.13	2.00	47	43	45	27.92	112.88	-22.88	90.25	-0.25	67.63	22.37	91.25

Table A5
Incidents data for Month M12

Month	Incidents/Tickets Ids	Start time	End Time	Turn around time	mR	X bar	mR.bar	3 Sigma (UCL)	3 Sigma (LCL)	2 Sigma (UCL)	2 Sigma (LCL)	1 Sigma (UCL)	1 Sigma (LCL)	mR bar(UCL)
M12	308	1.50	2.40	50		45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	309	2.45	2.55	10	40	45	16.00	112.88	-22.88	0.15	-0.25	67.63	22.37	52.29
	310	22.50	23.20	30	20	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	311	23.25	23.37	12	18	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	312	23.20	23.45	25	13	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	313	23.25	23.40	15	10	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	314	23.25	23.40	15	0	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	315	0.37	0.45	8	7	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	316	0.25	0.40	15	7	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	317	23.02	23.25	23	8	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	318	23.10	23.25	15	8	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	319	3.00	3.10	10	5	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	320	7.00	7.19	19	9	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	321	2.42	3.33	51	32	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	322	7.03	7.30	27	24	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	323	2.28	2.42	14	13	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	324	3.38	3.45	7	7	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	325	2.37	2.39	2	5	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	326	1.10	1.20	10	8	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	327	3.30	3.30	0	10	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	328	1.05	1.07	2	2	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	329	4.07	5.10	63	61	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	330	5.15	5.25	10	53	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	331	6.05	6.10	5	5	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29

Table A6
Incidents data for Month M13

Month	Incidents / Tickets Ids	Start time	End Time	Turn around	mR	X bar	mR bar	3 Sigma (UCL)	3 Sigma (LCL)	2 Sigma (UCL)	2 Sigma (LCL)	1 Sigma (UCL)	1 Sigma (LCL)	mR bar(UCL)
M13	332	2.37	2.40	3		45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	333	6.15	6.56	41	38	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	334	2.40	2.45	5	36	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	335	6.20	6.22	2	3	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	336	23.02	23.45	43	41	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	337	23.02	23.38	36	7	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	338	23.50	1.00	10	26	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	339	23.10	23.20	10	0	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	340	6.15	6.25	10	0	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	341	5.36	5.56	20	10	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	342	5.33	6.11	22	2	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	343	2.45	2.53	8	14	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	344	8.05	8.20	15	7	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	345	1.10	1.20	10	5	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	346	0.05	0.20	15	5	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	347	0.50	1.35	45	30	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	348	23.40	0.02	22	23	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	349	23.36	23.54	18	4	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	350	1.43	2.00	17	1	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	351	4.25	5.00	35	18	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	352	5.46	5.48	2	33	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	353	6.40	6.50	10	8	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	354	2.48	2.55	7	3	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	355	6.43	6.46	3	4	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	356	9.01	9.19	18	15	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	357	9.32	9.40	8	10	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	358	9.05	9.08	3	5	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	359	12.30	2.05	95	92	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	360	3.06	3.16	10	85	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	361	3.00	5.00	120	110	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	362	6.31	6.35	4	116	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	363	6.20	6.35	15	11	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	364	6.20	6.28	8	7	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	365	12.25	12.40	15	7	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	366	1.43	2.05	13	2	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	367	2.21	3.20	59	46	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	368	5.00	5.09	9	50	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	369	5.41	5.45	4	5	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	370	4.59	5.06	7	3	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	371	5.41	5.46	5	2	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	372	12.50	1.00	10	5	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	373	6.03	6.11	8	2	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	374	6.16	6.19	3	5	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	375	12.39	12.45	6	3	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	376	6.24	6.28	4	2	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	377	5.15	5.17	2	2	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	378	5.43	5.46	3	1	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	379	5.21	5.24	3	0	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	380	5.57	6.10	13	10	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	381	1.20	1.30	10	3	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	382	11.01	11.10	9	1	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	383	11.05	11.10	5	4	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	384	12.45	12.47	2	3	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	385	5.15	5.25	10	8	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	386	5.53	6.02	9	1	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	387	5.25	5.38	13	4	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	388	5.47	5.50	3	10	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	389	5.22	5.27	5	2	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29
	390	7.21	7.24	3	2	45	16.00	112.88	-22.88	90.25	-0.25	67.63	22.37	52.29

Table A7
Incidents data for Month M14

Month	Incidents / Tickets Ids	Start time	End Time	Turn around time	mR	X bar	mR bar	3 Sigma (UCL)	3 Sigma (LCL)	2 Sigma (UCL)	2 Sigma (LCL)	1 Sigma (UCL)	1 Sigma (LCL)	mR bar(UCL)
M14	391	1.32	2.00	28		45	8.00	112.88	-22.88	90.25	-0.25	67.63	22.37	26.14
	392	23.15	23.40	25	3	45	8.00	112.88	-22.88	90.25	-0.25	67.63	22.37	26.14
	393	3.01	3.18	17	8	45	8.00	112.88	-22.88	90.25	-0.25	67.63	22.37	26.14
	394	3.22	3.28	6	11	45	8.00	112.88	-22.88	90.25	-0.25	67.63	22.37	26.14
	395	12.41	12.50	9	3	45	8.00	112.88	-22.88	90.25	-0.25	67.63	22.37	26.14
	396	7.10	7.20	10	1	45	8.00	112.88	-22.88	90.25	-0.25	67.63	22.37	26.14
	397	2.43	2.50	7	3	45	8.00	112.88	-22.88	90.25	-0.25	67.63	22.37	26.14
	398	2.54	3.00	6	1	45	8.00	112.88	-22.88	90.25	-0.25	67.63	22.37	26.14
	399	7.17	7.22	5	1	45	8.00	112.88	-22.88	90.25	-0.25	67.63	22.37	26.14
	400	3.04	3.10	6	1	45	8.00	112.88	-22.88	90.25	-0.25	67.63	22.37	26.14
	401	1.18	1.27	9	3	45	8.00	112.88	-22.88	90.25	-0.25	67.63	22.37	26.14
	402	7.21	7.24	3	6	45	8.00	112.88	-22.88	90.25	-0.25	67.63	22.37	26.14
	403	2.53	3.00	7	4	45	8.00	112.88	-22.88	90.25	-0.25	67.63	22.37	26.14
	404	1.10	1.50	40	33	45	8.00	112.88	-22.88	90.25	-0.25	67.63	22.37	26.14
	405	8.03	8.08	5	35	45	8.00	112.88	-22.88	90.25	-0.25	67.63	22.37	26.14

Table A8
Incidents data for Month M15

Month	Incidents / Tickets Ids	Start time	End Time	Turn around	mR	X bar	mR bar	3 Sigma (UCL)	3 Sigma (LCL)	2 Sigma (UCL)	2 Sigma (LCL)	1 Sigma (UCL)	1 Sigma (LCL)	mR bar(UCL)
M15	406	2.57	3.02	5		45	5.00	112.88	-22.88	90.25	-0.25	67.63	22.37	16.34
	407	2.57	3.10	13	8	45	5.00	112.88	-22.88	90.25	-0.25	67.63	22.37	16.34
	408	2.37	2.40	3	10	45	5.00	112.88	-22.88	90.25	-0.25	67.63	22.37	16.34
	409	3.13	3.25	12	9	45	5.00	112.88	-22.88	90.25	-0.25	67.63	22.37	16.34
	410	7.20	7.30	10	2	45	5.00	112.88	-22.88	90.25	-0.25	67.63	22.37	16.34
	411	3.38	3.48	10	0	45	5.00	112.88	-22.88	90.25	-0.25	67.63	22.37	16.34
	412	2.41	2.48	7	3	45	5.00	112.88	-22.88	90.25	-0.25	67.63	22.37	16.34

Table A9
Incidents data for Month M16

Month	Incidents / Tickets Ids	Start time	End Time	Turn around time	mR	X bar	mR bar	3 Sigma (UCL)	3 Sigma (LCL)	2 Sigma (UCL)	2 Sigma (LCL)	1 Sigma (UCL)	1 Sigma (LCL)	mR bar(UCL)
M16	413	6.32	6.49	17		45	18.00	112.88	-22.88	90.25	-0.25	67.63	22.37	58.82
	414	2.37	2.43	6	11	45	18.00	112.88	-22.88	90.25	-0.25	67.63	22.37	58.82
	415	2.38	2.43	5	1	45	18.00	112.88	-22.88	90.25	-0.25	67.63	22.37	58.82
	416	6.56	7.06	10	5	45	18.00	112.88	-22.88	90.25	-0.25	67.63	22.37	58.82
	417	7.16	7.26	10	0	45	18.00	112.88	-22.88	90.25	-0.25	67.63	22.37	58.82
	418	12.54	1.30	36	26	45	18.00	112.88	-22.88	90.25	-0.25	67.63	22.37	58.82
	419	2.48	2.54	6	30	45	18.00	112.88	-22.88	90.25	-0.25	67.63	22.37	58.82
	420	8.19	8.27	8	2	45	18.00	112.88	-22.88	90.25	-0.25	67.63	22.37	58.82
	421	7.00	7.07	7	1	45	18.00	112.88	-22.88	90.25	-0.25	67.63	22.37	58.82
	422	2.43	2.48	5	2	45	18.00	112.88	-22.88	90.25	-0.25	67.63	22.37	58.82
	423	2.44	2.48	4	1	45	18.00	112.88	-22.88	90.25	-0.25	67.63	22.37	58.82
	424	2.10	3.25	75	71	45	18.00	112.88	-22.88	90.25	-0.25	67.63	22.37	58.82
	425	2.23	2.29	6	69	45	18.00	112.88	-22.88	90.25	-0.25	67.63	22.37	58.82