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STUDY OF SERVICE QUALITY CONTROL FOR TIME DELAY IN AN AIRLINE INDUSTRY

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ABSTRACT

We find service industries in all facets of our society. Functions performed by service industries include education, banking, healthcare, insurance, transportation (airlines, railroads, buses) and many others. The service industries provide a tangible product and an intangible component that affects customer satisfaction. The quality of a service can be broken down into two categories: effectiveness and efficiency. Effectiveness deals with meeting the desirable service attributes that are expected by the customer and efficiency concerns the time required for the services to be rendered. In this paper we considered the quality control problem in time delay of flights arriving and departure timings at DEVI AHILYA BAI AIRPORT at INDORE (M.P.) INDIA. By using the control charts for quality control we analyze the service problem in time delay at airport for different flights. After all the calculations we found the probability of a delay of 10 min or less is 0.5675 or about 56 %. Even though the average delay is less than the goal, so that from the calculation we can say that the company must still strive to reduce delay times because it will not meet the goal about 45% of the time.

Key words: TQM, EFQM, ASQC, SPC, X-chart, R-chart, UCL, LCL, LLCs, FNCs.

INTRODUCTION

Total Quality Management (TQM) is an integrated management approach that aim to continuously improve the performance of product, process and services to achieve and surpass customer's expectations and the quality has been treated as a major competing weapon by both the manufacturing industries and service providers to gain market share, improve productivity and profitability and sustain in business from long term perspective.

Therefore, organizations throughout the world dealing with products or services or both are contemplating to implement TQM principles for enhancing system effectiveness. To accomplish this objective, some key factors that contribute to the success of TQM efforts are to be identified. These key factors are often termed as critical success factors (CSFs). However, few critical success factor viz., leadership, customer satisfaction, and training and employee participation.

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In this struggling environment, airlines are forced to shift their focus towards customer oriented service quality (Chang & Yeh, 2002). It is extremely important for carriers not only to understand the perception of passengers of their service offerings, but as well find out what customers expect from the services (Chen & Chang, 2005) and what kind of services customers consider most important. In the airline industry, services are composed of very complex mix of intangibles as the airlines sell not physical objects but performances and experiences (Gursoy et al., 2005). Thus, service quality is a key to attract and keep loyal customers (Liou & Tzang, 2007; Chang & Yeh, 2002). The discussion then continues to service quality applied in case of airline industry and completed with discussion on customer expectations and experience management.

As we know that the airline transportation is growing service industry in India, Flight delays are of concern to passengers comfort and transport services. This thesis views service experience as a process and all the steps regarding customer satisfaction is taking during air transportation are listed and discussed. Service quality is created on each step of the process, and it is important to understand the customer preferences and expectations from the services. The research scope of the thesis is limited to young professionals who have recently entered or are about to enter full-time professional life. Survey has been chosen as a primary method of gathering empirical data as the most suitable method to reach as many respondents belonging to the target group as possible.

" An airline data were obtained from Davi-Ahilya Airport Indore observations on the average and range of delay times of flights (in minutes), R-charts and C-chart are used to get desired output from the observation taken, and comments on the performance level are given in the conclusion. In this problem our motive is to achieve 10 minute delay standard**"**.

Numerical set up

Step 1: Using a preselected sampling scheme and sample size, record measurements of the selected quality characteristic on the appropriate forms.

Step 2: For each sample, calculate the sample mean and range using the following formulas:

$$\bar{X} = \frac{\sum_{i=1}^{n} Xi}{n}$$

$$R = X_{max} - X_{min}$$

where X_i represents the observation, n is the sample size, X_{max} is largest observation, and X_{min} is the smallest observation.

Step 3: Obtain and draw the centre line and the trial control limits for each chart. For $\bar{\bar{X}}$ chart, the center line $\bar{\bar{X}}$ is given by

$$\bar{\bar{X}} = \frac{\sum_{i=1}^{g} \bar{X}}{g}$$

where g represents the number of samples. For the R-chart, the centre line R is found from

$$\bar{R} = \frac{\sum_{i=1}^{g} Ri}{g}$$

Conceptually, the 3 contra limits for the X chart are

$$\bar{\bar{X}} \pm 3\sigma\bar{\bar{X}}$$

Rather than compute $\sigma\bar{\bar{X}}$ from the raw data, we can use the relation between the process standard deviation σ (or the standard deviation of the individual items) and the mean of the ranges ($\bar{\bar{X}}$). Multiplying factors used to calculate the centre line and control limits are given in Appendix A-3. When sampling from a population that is normally distributed, the distribution of the statistic W=R/ σ (known as the relative range) is dependent on the sample size n. the mean of W is represented by d_2 and is tabulated in Appendix A-3. Thus, an estimate of the process standard deviation is

$$\sigma = \frac{\bar{R}}{d_2}$$

The control limits for an $\bar{X}$ -chart are therefore estimated as

$$(UCL_{\bar{X}}, LCL_{\bar{X}}) = \bar{X} \pm \frac{3\sigma}{\sqrt{n}}$$

$$= \bar{X} \pm \frac{3\bar{R}}{\sqrt{n}d_2}$$

$$(UCL_{\bar{X}}, LCL_{\bar{X}}) = \bar{X} \pm A_2\bar{R}$$

Where $A_2 = 3/\sqrt{nd_2}$ and is tabulated in Appendix A-3. Above Equation is the working equation for determining the $\bar{X}$ chart control limits, given $\bar{R}$.

The control limits for the R-chart are conceptually given by

$$(UCL_R, LCL_R) = \bar{R} \pm 3\sigma_R$$

Since R= σ W, have σ_R = $\sigma\sigma_W$. In Appendix A-3, σ_W is tabulated as d_3. Using above eq. we get

$$\sigma_R = \left(\frac{\bar{R}}{d_2}\right)d_3$$

The control limit for the R-chart are estimated as

$$UCL_R = \bar{R} + 3d_3\left(\frac{\bar{R}}{d_2}\right) = D_4\bar{R}$$

$$LCL_R = \bar{R} - 3d_3\left(\frac{\bar{R}}{d_2}\right) = D_3\bar{R}$$

Where

$$D_4 = 1 + \frac{3d_3}{d_2} \ and \ = D_3 = \max\left(0.1 - \frac{3d_3}{d_2}\right)$$

Above Equation is the working equation for calculating the control limits. Values of D_4 and D_3 are tabulated in AppendixA-3.

Step 4: Plot the values of the range on the control chart for range, with the centre line and the control limits drawn. Determine whether the points are in statistical control. If not, investigate the special causes associated with the out-of-control points and take appropriate remedial action to eliminate special causes.

Typically, only some of the rules are used simultaneously. The most commonly used criterion for determining and out-of-control situation is the presence of a point outside the control limits.

An R-chart is usually analyzed before the $\bar{\bar{X}}$ -chart to determine out-of-control situations. An R-chart reflects process variability, which should be brought to control first. As shown by above equation the control limits for an $\bar{X}$ chart involve the process variability and hence $\bar{R}$. Therefore, if an R-chart shows an out-of-control situation, the limits on the $\bar{X}$-chart may not be meaningful.

Let's consider figure On the R-chart, sample 12 plots above the upper control limit and so is out of control. The $\bar{X}$-chart, however, does not show the process to be out of control. Suppose the special cause is identified as a problem with a new vendor who supplies raw materials and components. The task is to eliminate the cause perhaps by choosing a new vendor or requiring evidence of statistical process control at the vendor's plant.

Step 5: Delete the out-of-control point (s) for which remedial actions have been taken to remove special causes (in this case, sample 12) and use the remaining samples (here they are samples 1-11 and 13-15) to determine the revised centre line and control limits for the $\bar{X}$-and R-charts.

These limits are known as the revised control limits. The cycle of obtaining information, determining the trial limits, finding out-of-control points, identifying and correcting special causes, and determining revised control limits then continues. The revised control limits will serve as trial control limits for the immediate future until the limits are revised again. This ongoing process is a critical component of continuous improvement.

A point of interest regarding the revision of R-charts concerns observations that plot below the lower control limit when the lower control limit is greater than zero. Such points that fall below LCL_R are, statistically speaking, out of control; however, they are also desirable because they indicate unusually small variability within the sample, which is, after all, one of our main objectives. Such small variability is most likely due to special causes.

If the user is convinced that the small variability does indeed represent the operating state of the process during that time, an effort should be made to identify the causes. If such conditions can be created consistently, process variability will be reduced. The process should be set to match those favourable conditions, and the observations should be retained for calculating the revised centre time and the revised control limits for the R-chart.

Step 6: Implement the control charts.

The $\bar{X}$ - and R-charts should be implemented for future observations, using the revised center line and control limits. The charts should be displayed in a conspicuous place where they will be visible to operators, supervisors, and managers. Statistical process control will be effective only if everyone is committed to it-from the operator to the chief executive officer.

Results and discussion:

As per the above problem the R-chart (R) and C-chart (C) for the delay time is constructed first. Then find the control limits which are UCL and LCL.

$$UCL= D_4 R$$

$$LCL = D_3 R$$

Where the control chart multiplying factors D_4 and D_3 are found from Appendix A-3 for a sample size 7. The chart for the average delay X is then constructed. After that the control limits UCL and LCL are again found.

$$UCL= X+A_2R$$

$$LCL= X - A_2R$$

Where A_2 is found from Appendix A-3,

This the methodology for constructing R- chart and X- chart. By solving all the observations we get the final results and both R and X chart.

Calculation for X:

For finding the values of X we sum all the values of delay (in min.) and divided by no. of observations. The calculation of X is given by-

Value of X = sum of all delays (O_1+ O_2+ $O_{3\,+}$ $O_{4\,+}$ O_5+ O_6+ O_7)/No. of observations

The values of X are given in the following table.

Calculation for R:

For finding the value of R (range) subtracting maximum delay in minimum delay and calculation is given by

Value of R = maximum delay (O_1 to O_7) – minimum delay (O_1 to O_7)

After all the calculations and from the cumulative standard normal distribution table in Appendix A-3, the probability of a delay of 10 min or less is 0.5675 or about 56 %. Even though the average delay is less than the goal, so that from the above calculation we can say that the company must still strive to reduce delay times because it will not meet the goal about 45% of the time.

TABLE-1 DETAILED FLIGHTS TIMINING

FLIGHT NO.	FROM	TO	DEP. TIME	DELAY IN MIN.	FREQUENCY
9W2374/3374	INDORE	DELHI	850	10	DAILY
AI633	INDORE	DELHI	745	5	DAILY
VA-202	INDORE	JABALPUR	745	10	DAILY
S24382/7110	INDORE	MUMBAI	820	12	DAILY
9W2513/3513	INDORE	LUCK/PATNA	815	14	DAILY
6E-435	INDORE	DELHI/SRINAGAR	1010	15	DAILY
9W2821/3821	INDORE	JAIPUR/CHANDIGARH	1300	12	DAILY
VA-208	INDORE	BHOPAL	1425	14	DAILY
9W2022/3022	INDORE	MUMBAI	1340	10	DAILY
9W2402/3402	INDORE	DELHI	1245	5	DAILY
9W-2773/3773	INDORE	HYD/VTZ	1435	7	DAILY
9W-2018/3018	INDORE	PUNE	1600	8	DAILY
6E-436	INDORE	NAGPUR/BANGLURU	1845	9	DAILY
9W-2822/3822	INDORE	RAIPUR/KOLKATTA	1635	8	DAILY
SG-1053	INDORE	BHOPAL/HYD	1910	12	1,3,5,7
SG-1063	INDORE	HYD	2015	15	2,4,6
S2-4794/7142	INDORE	DELHI	1915	15	DAILY
9W-2383/3383	INDORE	NAGPUR	1920	14	Tue
9W-2384/3384	INDORE	MUMBAI	2045	10	1,3,4,5
9W-2514/3514	INDORE	AHEMDABAD	2105	13	DAILY
AI-634	INDORE	MUMBAI	2110	15	DAILY
6.00E-245	INDORE	MUMBAI	1115	16	DAILY
6.00E-252	INDORE	RAIPUR/KOLATTA	1515	12	DAILY

TABLE-2 CALCULATED SHEET FOR TIME DELAY

ARR. time	Delay in min						
	O_1	O_2	O_3	O_4	O_5	O_6	O_7
820	7	10	10.5	9.5	6.8	7.2	8.1
715	10.2	10.7	11.2	9.2	7.8	12.8	9.4
	10.2	8.7	15.8	10.3	8.5	9	10.3
750	5.6	7.3	9.4	6.4	7.6	7.7	11.3
745	9.3	5.8	7.9	10.3	7.8	7.3	9.4
935	7.7	15.3	15	11.2	9	8.3	9.2
1230	7	9.2	11.2	12.4	6.8	11.2	12.2
1410	11	10	12.3	16	11.5	9.5	9.3
1300	10	12.5	11.5	9.5	11.2	5.8	7.8
1215	11.4	9.4	9	9.5	12.5	12	12.5
1405	15.4	12.4	18.5	9.7	17	18.1	15.5
1530	12.3	13.2	11	11.2	12	15.6	9.2
1815	11.2	9.4	9.2	9.4	6.9	8.9	12.4
1605	12.4	13.4	10	13	8.6	15.3	12.5
1850	12.4	8.5	9.5	9.4	8.7	5.8	11.4
1955	9	5.8	8	11	11	9.5	10
1845	10.3	12.3	12.6	9.5	7.5	8.9	8.6
1840	9	8	9.3	11.6	6.4	12	9.7
1955	8	12	13	15	9	9.5	7
2035	9	9	11	10	10	14	9.6
2035	9	9.9	7.9	14	9	9.9	10.4
1045	10	10	10	9.3	11	15	10.6
1445	8	15	12	8	9	10	10
1930	5	11	10	11	9	11	10.7

TABLE-3 CALUCLATED SHEET FOR AVERAGE TIME DELAY

Sr. No.	Average Delay (min)	Range
1	7	3.3
2	10.2	5
3	10.2	7.3
4	5.6	4.9
5	9.3	4.5
6	7.7	7.6
7	7	5.4
8	11	6.7
9	10	6.7
10	11.4	3.5
11	15.4	8.4
12	12.3	6.4
13	11.2	5.5
14	12.4	6.7
15	12.4	5.6
16	9	5.2
17	10.3	5.1
18	9	5.6
19	8	6
20	9	5
21	9	6.1
22	10	5.7
23	8	7
24	5	6

TABLE-4 CALCULATED VALUES OF X-CHART & R-CHART

Sr. No.	Values for X	Values for R
1	8.4	3.3
2	10.2	5
3	10.4	7.3
4	7.9	4.9
5	8.3	4.5
6	10.8	7.6
7	10.0	5.4
8	11.4	6.7
9	9.8	6.7
10	10.9	3.5
11	15.2	8.4
12	12.1	6.4
13	9.6	5.5
14	12.2	6.7
15	9.4	5.6
16	9.2	5.2
17	10.0	5.1
18	9.4	5.6
19	10.5	6
20	10.4	5
21	10.0	6.1
22	10.8	5.7
23	10.3	7
24	9.7	6

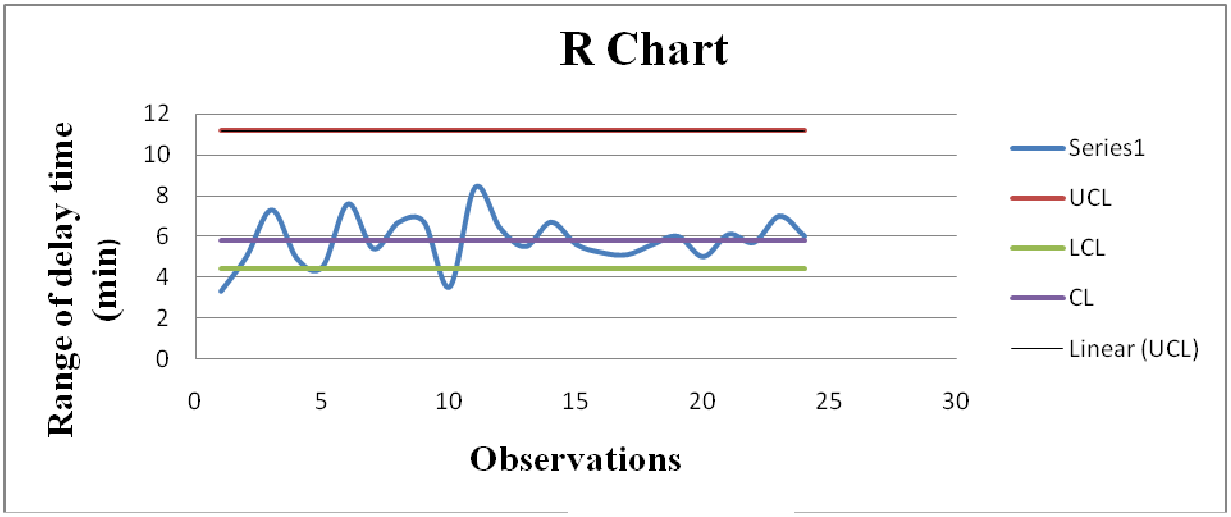

FIGURE-1 Calculated R-Chart

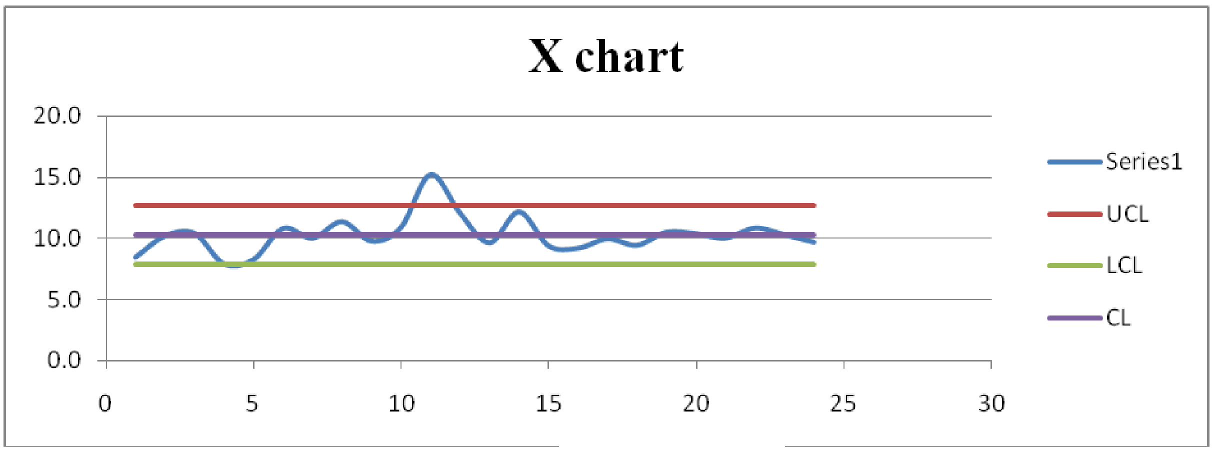

FIGURE-2 Calculated X-Chart

CONCLUSION

In the recent years the importance of service quality has been increasing immensely in the airline industry. Although in many aspects airlines are still behind in comparison to other industries, it has been made apparent that environmentalism and social responsibility issues will only increase in importance in the coming years and decades.

With this thesis we believe that we manage to give the reader a good overall idea of the current situation of the airline industry and its future regarding sustainability.

Throughout the working process we were able to get a good overview of responsibility in service quality practices and the impact of quality control in the airline industry. Surprisingly there are tremendous differences in service quality and quality control focus points between different airlines.

We found the thesis topic to be quite interesting because of the increasing visibility of time delay and social issues in today's media and business world. In retrospect we have to admit that drafting timetables and sticking to deadline is essential. We encountered several problems along the process, such as finding appropriate information, structuring the thesis, choosing the issues which need to be addressed and trying to make the thesis look like one consistent piece of work.

The analysis part of our thesis is based on information given by the chosen airport Indore (M.P.) either in quality control reports or on the complains web sites. Most of the airlines we have chosen and discussed provide proper information about their quality control actions which need to be considered carefully. Airline business as any other business is striving for success; therefore airline operators will praise their own company in order to be competitive, regardless of the truth. Going through the reports we got the impression that all airlines seemed to do everything correctly and efficiently regarding quality control, but there is no real proof for it. Because we did not use outside information besides the airlines web pages bias is likely to occur, leading to a rather one sided view of airlines quality programs.

In this thesis we analyzed the quality control problem in time delay of flights arriving and departure timings at DEVI AHILYA BAI AIRPORT at INDORE (M.P.) INDIA. By using the control charts for quality control we analyze the service problem in time delay at airport for different flights. In this study we calculate the values for the making of R-chart and X-chart. X chart in between average delay and observations and R- chart between range in delay and the observations. By these charts we calculate UCL and LCL values. After all the calculations and from the cumulative standard normal distribution table in Appendix A-3, the probability of a delay of 10 min or less is 0.5675 or about 56 %. Even though the average delay is less than the goal, so that from the above calculation we can say that the company must still strive to reduce delay times because it will not meet the goal about 45% of the time.

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APPENDIX-1

Observation in sample n	**X- Chart**		
	Factors for control limits		
	A	**A2**	**A3**
2	2.121	1.880	2.659
3	1.732	1.023	1.954
4	1.500	0.729	1.628
5	1.342	0.577	1.427
6	1.225	0.483	1.287
7	1.134	0.419	1.182
8	1.061	0.373	1.099
9	1.000	0.337	1.032
10	0.949	0.308	0.975
11	0.905	0.285	0.927
12	0.866	0.266	0.886
13	0.832	0.249	0.850
14	0.802	0.235	0.817
15	0.775	0.223	0.789
16	0.750	0.212	0.763
17	0.728	0.203	0.739
18	0.707	0.194	0.718
19	0.688	0.187	0.698
20	0.671	0.180	0.680
21	0.655	0.173	0.663
22	0.640	0.167	0.647
23	0.626	0.162	0.633
24	0.612	0.157	0.619
25	0.600	0.153	0.606

APPENDIX-2

S- CHART					
Factors for center line		**Factors for control limits**			
c4	**1/c4**	**B3**	**B4**	**B5**	**B6**
0.7979	1.2533	0.000	3.267	0.000	2.606
0.8862	1.1284	0.000	2.568	0.000	2.272
0.9213	1.0854	0.000	2.266	0.000	2.088
0.9400	1.0638	0.000	2.089	0.000	1.964
0.9515	1.0510	0.030	1.970	0.029	1.874
0.9594	1.0423	0.118	1.882	0.113	1.806
0.9650	1.0363	0.185	1.815	0.179	1.751
0.9693	1.0317	0.239	1.761	0.232	1.707
0.9727	1.0281	0.284	1.716	0.276	1.669
0.9754	1.0252	0.321	1.679	0.313	1.637
0.9776	1.0229	0.354	1.646	0.346	1.610
0.9794	1.0210	0.382	1.618	0.374	1.585
0.9810	1.0194	0.406	1.594	0.399	1.563
0.9823	1.0180	0.428	1.572	0.421	1.544
0.9835	1.0168	0.448	1.552	0.440	1.526
0.9845	1.0157	0.466	1.534	0.458	1.511
0.9854	1.0148	0.482	1.518	0.475	1.496
0.9862	1.0140	o.497	1.503	0.490	1.483
0.9869	1.0133	0.510	1.490	0.504	1.470
0.9876	1.0126	0.523	1.477	0.516	1.459
0.9882	1.0119	0.534	1.466	0.528	1.448
0.9887	1.0114	0.545	1.455	0.539	1.438
0.9892	1.0109	0.555	1.445	0.549	1.429
0.9896	1.0105	0.565	1.435	0.559	1.420

APPENDIX -3

R-Charts						
Factors for centre line		**Factors for control limits**				
d2	**1/d2**	**d3**	**D1**	**D2**	**D3**	**D4**
1.128	0.8865	0.853	0.000	3.686	0.000	3.267
1.693	0.5907	0.888	0.000	4.358	0.000	2.574
2.059	0.4857	0.880	0.000	4.698	0.000	2.282
2.326	0.4299	0.864	0.000	4.918	0.000	2.114
2.534	0.3946	0.848	0.000	5.078	0.000	2.004
2.704	0.3698	0.833	0.204	5.204	0.076	1.924
2.847	0.3512	0.820	0.388	5.306	0.136	1.864
2.970	0.3367	0.808	0.547	5.393	0.184	1.816
3.078	0.3249	0.797	0.687	5.469	0.223	1.777
3.137	0.3188	0.787	0.811	5.535	0.256	1.744
3.258	0.3069	0.778	0.922	5.594	0.283	1.717
3.336	0.2998	0.770	1.025	5.647	0.307	1.693
3.407	0.2935	0.763	1.118	5.696	0.328	1.672
3.472	0.2880	0.756	1.203	5.741	0.347	1.653
3.532	0.2831	0.750	1.282	5.782	0.363	1.637
3.588	0.2787	0.744	1.356	5.820	0.378	1.622
3.640	0.2747	0.739	1.424	5.856	0.391	1.608
3.689	0.2711	0.734	1.487	5.891	0.403	1.597
3.735	0.2677	0.729	1.549	5.921	0.415	1.585
3.778	0.2647	0.724	1.605	5.951	0.425	1.575
3.819	0.2618	0.720	1.659	5.979	0.434	1.566
3.858	0.2592	0.716	1.710	6.006	0.443	1.557
3.895	0.2567	0.712	1.759	6.031	0.451	1.548
3.931	0.2544	0.708	1.806	6.056	0.459	1.541

APPENDIX -4

z	0.0000	0.0100	0.0200	0.0300	0.0400	0.0500	0.0600	0.0700	0.0800	0.0900
-3.40	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0002
-3.30	0.0005	0.0005	0.0005	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0003
-3.20	0.0007	0.0007	0.0006	0.0006	0.0006	0.0006	0.0006	0.0005	0.0005	0.0005
-3.10	0.0010	0.0009	0.0009	0.0009	0.0008	0.0008	0.0008	0.0008	0.0007	0.0007
-3.00	0.0013	0.0013	0.0013	0.0012	0.0012	0.0011	0.0011	0.0011	0.0010	0.0010
-2.90	0.0019	0.0018	0.0018	0.0017	0.0016	0.0016	0.0015	0.0015	0.0014	0.0014
-2.80	0.0026	0.0025	0.0024	0.0023	0.0023	0.0022	0.0021	0.0021	0.0020	0.0019
-2.70	0.0035	0.0034	0.0033	0.0032	0.0031	0.0030	0.0029	0.0028	0.0027	0.0026
-2.60	0.0047	0.0045	0.0044	0.0043	0.0041	0.0040	0.0039	0.0038	0.0037	0.0036
-2.50	0.0062	0.0060	0.0059	0.0057	0.0055	0.0054	0.0052	0.0051	0.0049	0.0048
-2.40	0.0082	0.0080	0.0078	0.0075	0.0073	0.0071	0.0069	0.0068	0.0066	0.0064
-2.30	0.0107	0.0104	0.0102	0.0099	0.0096	0.0094	0.0091	0.0089	0.0087	0.0084
-2.20	0.0139	0.0136	0.0132	0.0129	0.0125	0.0122	0.0119	0.0116	0.0113	0.0110
-2.10	0.0179	0.0174	0.0170	0.0166	0.0162	0.0158	0.0154	0.0150	0.0146	0.0143
-2.00	0.0228	0.0222	0.0217	0.0212	0.0207	0.0202	0.0197	0.0192	0.0188	0.0183
-1.90	0.0287	0.0281	0.0274	0.0268	0.0262	0.0256	0.0250	0.0244	0.0239	0.0233
-1.80	0.0359	0.0351	0.0344	0.0336	0.0329	0.0322	0.0314	0.0307	0.0301	0.0294
-1.70	0.0446	0.0436	0.0427	0.0418	0.0409	0.0401	0.0392	0.0384	0.0375	0.0367
-1.60	0.0548	0.0537	0.0526	0.0516	0.0505	0.0495	0.0485	0.0475	0.0465	0.0455
-1.50	0.0668	0.0655	0.0643	0.0630	0.0618	0.0606	0.0594	0.0582	0.0571	0.0559
-1.40	0.0808	0.0793	0.0778	0.0764	0.0449	0.0735	0.0721	0.0708	0.0694	0.0681
-1.30	0.0968	0.0951	0.0934	0.0918	0.0901	0.0885	0.0869	0.0853	0.0838	0.0823
-1.20	0.1151	0.1131	0.1112	0.1093	0.1075	0.1056	0.1038	0.1020	0.1003	0.0985
-1.10	0.1357	0.1335	0.1314	0.1292	0.1271	0.1251	0.1230	0.1210	0.1190	0.1170
-1.00	0.1587	0.1562	0.1539	0.1515	0.1492	0.1469	0.1446	0.1423	0.1401	0.1379
-9.00	0.1841	0.1841	0.1788	0.1762	0.1736	0.1711	0.1685	0.1660	0.1635	0.1611
-8.00	0.2119	0.2090	0.2061	0.2033	0.2005	0.1977	0.1949	0.1922	0.1894	0.1867
-7.00	0.2420	0.2389	0.2358	0.2327	0.2296	0.2266	0.2236	0.2206	0.2177	0.2148
-6.00	0.2743	0.2709	0.2676	0.2643	0.2611	0.2578	0.2546	0.2514	0.2483	0.2451
-5.00	0.3085	0.3050	0.3015	0.2981	0.2946	0.2912	0.2877	0.2843	0.2810	0.2776
-4.00	0.3446	0.3409	0.3372	0.3336	0.3300	0.3264	0.3228	0.3192	0.3156	0.3121

-3.00	0.3821	0.3783	0.3745	0.3707	0.3669	0.3632	0.3594	0.3557	0.3520	0.3483
-2.00	0.4207	0.4168	0.4129	0.4090	0.4052	0.4013	0.3974	0.3936	0.3897	0.3859
-1.00	0.4602	0.4562	0.4522	0.4483	0.4443	0.4404	0.4364	0.4325	0.4286	0.4247
0.00	0.5000	0.4960	0.4920	0.4880	0.4840	0.4801	0.4761	0.4721	0.4681	0.4641
0.00	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.10	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.20	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6046	0.6103	0.6141
0.30	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.40	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.50	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.60	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.70	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.80	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.90	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.00	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.9577	0.8599	0.8621
1.10	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.20	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8990	0.8997	0.9015
1.30	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.40	0.9192	0.9247	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.50	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.60	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.70	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.80	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.90	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.00	0.9772	0.9778	0.9783	0.9788	0.9793	0.9897	0.9803	0.9808	0.9812	0.9817
2.10	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.20	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.30	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.40	0.9981	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.50	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.60	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.70	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.80	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.90	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986

3.00	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990
3.10	0.9990	0.9991	0.9991	0.9991	0.9992	0.9992	0.9992	0.9992	0.9993	0.9993
3.20	0.9993	0.9993	0.9994	0.9994	0.9994	0.9994	0.9994	0.9995	0.9995	0.9995
3.30	0.9995	0.9995	0.9995	0.9996	0.9996	0.9996	0.9996	0.9996	0.9996	0.9997

Z	**F(z)**		**Z**	**F(z)**		**Z**	**F(z)**	
3.50	0.99976	73709	4.00	0.99996	83288	4.50	0.99999	66023
3.55	0.99980	73844	4.05	0.99997	43912	4.55	0.99999	73177
3.60	0.99984	8914	4.10	0.99997	93425	4.60	0.99999	78875
3.65	0.99986	88798	4.15	0.99998	33762	4.65	0.99999	83403
3.70	0.99989	22003	4.20	0.99998	66543	4.70	0.99999	86992
3.75	0.99991	15827	4.25	0.99998	93115	4.75	0.99999	89829
3.80	0.99992	76520	4.30	0.99998	14601	4.80	0.99999	92067
3.85	0.99994	9411	4.35	0.99999	31931	4.85	0.99999	3827
3.90	0.99995	19037	4.40	0.99999	45875	4.90	0.99999	95208
3.95	0.99996	9244	4.45	0.99999	57065	4.95	0.99999	96289