UNIVERSITI SAINS MALAYSIA

Peperiksaan Semester Kedua
Sidang Akademik 2006/2007

April 2007

EPM 332/3 – Kualiti & Kebolehpercayaan

Masa : 3 jam

ARAHAN KEPADA CALON :

Sila pastikan bahawa kertas soalan ini mengandungi **TUJUH (7)** mukasurat bercetak, **ENAM (6)** helaian lampiran dan **ENAM (6)** soalan sebelum anda memulakan peperiksaan.

Jawab **LIMA (5)** soalan sahaja.

Sila jawap **DUA (2)** soalan dari **BAHAGIAN A** dan **DUA (2)** soalan dari **BAHAGIAN B.**

Jawapan bagi setiap soalan hendaklah dimulakan pada mukasurat yang baru.

Lampiran:

1. Factors for Computing Central Lines and 3σ Control Limits for $\bar{X}$, s and R Chart
[1 mukasurat]

2. The Poison Distribution $P(c) = \frac{(np_o)}{c!} e^{-np_o}$ (Cumulative Values Are in Parentheses)
[5 mukasurat]

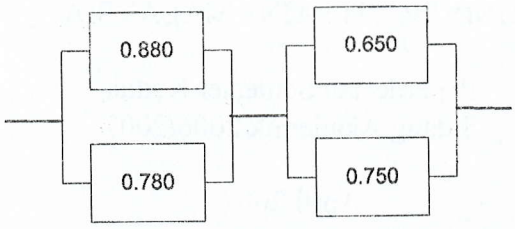
...2/-

BAHAGIAN A

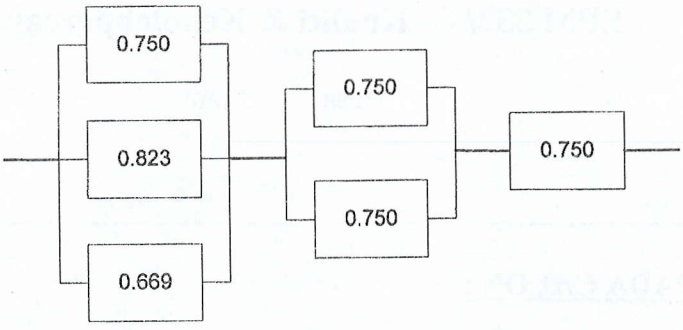
S1. [a] Tentukan keboleharapan bagi sistem di bawah

Determine the reliability of the system below.

i.



ii.



(30 markah)

[b] Berikan maksud lelebihan peringkat tinggi dan lebihan peringkat rendah.

Define high level redundancy and low level redundancy.

(20 markah)

[c] Sebuah syarikat ingin menambahbaik keboleharapan sistem penghantaran isyarat radionya. Tiga unit penguat radio dibeli dengan kadar kegagalan individu 0.004, 0.005 dan 0.006 (100 jam) dan dua alternatif sambungan telah ditentukan. Alternatif 1 ialah untuk menyambungnya dalam bentuk selari. Alternatif 2 ialah untuk menyambungnya sebagai suatu sistem berjaga tiga komponen (anggap keboleharapan suis ialah 100%). Buat perbandingan berdasarkan nilai keboleharapan bagi kedua-dua alternatif tersebut.

A company will like to improve the reliability of its radio signal transmission system. Three units of radio amplifier with individual failure rate of 0.004, 0.005 and 0.006 (100 hours) are bought and two alternatives of connection are being decided. Alternative 1 is to connect them in parallel. Alternative 2 is to connect as a three-component standby system (Assume 100% reliability of the switch). Make comparison based on their reliabilities of both alternatives.

(50 markah)

S2. [a] **25 komponen diuji selama 15 jam. Pada penghujung ujikaji, 3 komponen telah gagal pada masa 2, 5 dan 6 jam tanpa digantikan. Apakah kadar kegagalan kes tersebut?**

25 parts are tested for 15 hours. At the end of the test, 3 parts had failed at 2, 5, 6 hour without being replaced. What is the failure rate?

(10 markah)

[b] **Tentukan keboleharapan pada t = 80 jam bagi masalah di mana $\overline{m}$ = 125 jam dan mempunyai kadar kegagalan malar. Apakah keboleharapan pada t = 125 jam pada t = 160 jam?**

Determine the reliability at t = 80 hours for the problem where $\overline{m}$ = 125 hours and there is a constant failure rate. What is the reliability at t = 125 hours? At t = 160 hours?

(10 markah)

[c] **Kirakan keboleharapan pada 6000 kitar bagi suis dengan hayat purata sebanyak 5500 kitar dan sisihan piawai sebanyak 165 kitar, dengan**

(i) Taburan normal
(ii) Taburan Weibull (β=3.5)
(iii) Bagi kedua-dua kes (normal dan Weibull), berapa lamakah masa operasi bagi 6500 kitar.

Calculate the reliability at 6000 cycles of a switch with a mean life of 5500 cycles and a standard deviation of 165 cycles, with

(i) Normal distributon
(ii) Weibull distribution $(\beta = 3.5)$
(iii) For both cases (Normal and Weibull) how many operating time of 6500 cycles.

(40 markah)

[d] **Sejak tahun lepas, sebuah kilang telah memperkenalkan penyelenggaraan pencegahan harian antara masa kerja shif. Apabila sebuah mesin mengalami kerosakan semasa shif kerja, ia mengakibatkan nilai kerugian pengeluaran dan kos pembaikan sebanyak RM 350. Rekod kerosakan lepas (bagi jangkamasa sebelum perlaksanaan penyelenggaraan pencegahan) ditunjukkan seperti di bawah.**

For the past year, a factory has introducing daily preventive maintenance between shifts. When a machine does break down during a working shift, it costs about RM 350 in lost production and repair costs. The past breakdown records (for the period before the preventive maintenance), are as shown below.

Bilangan kerosakan dalam seminggu *Number of Breakdown Per Week*	**Bilangan minggu berlakunya kerosakan** *Number of Weeks In Which Breakdowns Occurred*
0	**1**
1	**1**
2	**3**
3	**5**
4	**9**
5	**11**
6	**7**
7	**8**
8	**5**

Penyelenggaraan pencegahan memerlukan kos sebanyak RM 120 seminggu. Semenjak penyelenggaraan pencegahan dilaksanakan, didapati purata kerosakan yang berlaku sebanyak tiga kerosakan seminggu. Ianya tidak jelas menyatakan bahawa penyelenggaraan pencegahan adalah pulangan kewangan terbaik bagi kilang tersebut. Apakah analisis anda terhadap situasi tersebut dan adakah anda fikir pihak syarikat sepatutnya meneruskan penyelenggaran pencegahan tersebut?

The preventive maintenance cost is RM 120 per week. Since the implementation of preventive maintenance, it is noted that an average of three breakdowns per week happened. It is not certain that the preventive maintenance is in the best financial interest for the factory. What is your analysis of this situation and do you think the company should continue its preventive maintenance.

(40 markah)

S3. Tempoh masa untuk membaiki sesuatu sistem adalah seperti berikut: 0.8, 1.5, 1.6, 2.1, 2.4, 2.5, 2.7, 3.3, 3.5, 4.2, 4.5 dan 4.8 jam. Dengan menggunakan taburan log-normal, jawab soalan-soalan berikut :

The times to repair a certain system are as follows : 0.8, 1.5, 1.6, 2.1, 2.4, 2.5, 2.7, 3.3, 3.5, 4.2, 4.5 and 4.8 hr. Using log-normal distribution, answer the following questions :

(i) Apakah kebolehsenggaraan bagi masa henti yang dibenarkan (D) selama 3 jam?

What is the maintainability for an allowed downtime (D) of 3 hour?

(25 markah)

(ii) Apakah masa henti yang dibenarkan (D) bagi 90% kebolehsenggaraan?

What must the allowed downtime (D) be for a maintainability of 90%?

(25 markah)

(iii) **Apakah MTTR yang baru bagi 90% kebolehsenggaraan dan masa henti yang dibenarkan (D) selama 3 jam?**

What is the new MTTR for 90% maintainability and an allowed downtime (D) of 3 hours?

(20 markah)

(iv) **Dengan MTTR dari (iii) dan sekiranya sistem mempunyai MTBF selama 80 jam, kirakan kebolehsediaan semula jadi?**

MTTR from (iii) and if the system has a MTBF of 80 hours, calculate the inherent availability.

(15 markah)

(v) **Dengan MTBF sebanyak 80 jam, kirakan bilangan kerosakan kekal yang mungkin dijangkakan dalam jangkamasa perancangan selama 200 jam dengan 90% kebolehsenggaraan.**

with the MTBF of 80 hours, calculate the number of unrepaired failures that would be expected in a planning period of 200 hours for a 90% maintainability.

(15 markah)

BAHAGIAN B

S4. [a] **Pengurusan Kualiti Menyeluruh memfokuskan kepada pengurusan atau kualiti? Terangkan jawapan anda. Bincangkan penambahbaikan yang dicapai di dalam kualiti menyeluruh bagi firma pengeluaran berdasarkan kepada 14 ciri-ciri Dr. Deming.**

Is Total Quality Management focusing on management or quality? Explain your answer. Discuss the improvement achieved in total quality of a firm's production based on Dr. Deming 14 points.

(50 markah)

[b] **Berikan maksud kualiti terhadap sesebuah produk. Berikan 5 teknik dan aktiviti-aktiviti yang perlu disepadukan untuk menambahbaik kualiti.**

Define quality in term of a product. Provide the five techniques and activities that is to be integrated in order to improve quality.

(20 markah)

[c] **Apakah maksud piawaian antarabangsa? Huraikan peranan ISO dalam penambahbaikan kualiti hidup.**

What international standardization means? Describe the ISO standards role in improving the quality of life.

(30 markah)

S5. [a] **Ketebalan (mm) bagi papan nipis dikawal. Jadual berikut S5[a] memberikan data bagi ketebalan papan nipis untuk 25 sampel. Setiap sampel mempunyai 3 papan nipis. Jawab soalan berikut.**

Thickness (mm) of a certain board is monitored. The following Table Q5[a] gives data of the boards thickness for 25 samples. Each sample has 3 board. Answer the following.

(i) **Apakah jenis carta yang akan digunakan?**

Which type of chart will you use?

(ii) **Tentukan garisan tengah dan had kawalan atas dan had kawalan bawah.**

Determine the centre line and upper and lower control limits.

(iii) **Tentukan sama ada proses berada dalam kawalan atau tidak.**

Find out whether process is in control.

Bilangan Sampel Sample number	X_1	X_2	X_3	**Bilangan Sampel** Sample number	X_1	X_2	X_3
1	6.29	6.36	6.40	14	6.45	6.40	6.31
2	6.30	6.31	6.22	15	6.19	6.44	6.32
3	6.28	6.31	6.33	16	6.31	6.27	6.30
4	6.34	6.30	6.31	17	6.16	6.23	6.31
5	6.19	6.28	6.30	18	6.30	6.30	6.26
6	6.13	6.29	6.34	19	6.36	6.31	6.29
7	6.30	6.39	6.25	20	6.40	6.35	6.29
8	6.28	6.27	6.22	21	6.28	6.25	6.16
9	6.23	6.26	6.33	22	6.15	6.25	6.19
10	6.31	6.31	6.33	23	6.30	6.32	6.30
11	6.35	6.30	6.38	24	6.35	6.29	6.35
12	6.23	6.30	6.30	25	6.23	6.29	6.30
13	6.35	6.31	6.30				

Jadual S5 [a]
Table Q5[a]

(50 markah)

[b] **Senaraikan sembilan (9) alatan kawalan kualiti, terangkan keberkesanan carta kawalan dalam penambahbaikan kualiti akhir produk. Apakah kelemahan-kelemahan yang berkaitan dengan carta kawalan.**

List nine (9) different quality control tools, explain the effectiveness of control chart in improving the end product quality. What are the weaknesses associated with control charts?

(30 markah)

[c] **Bezakan antara data atribut dan data pembolehubah, berikan contoh yang sesuai bagi setiap jenis data. Huraikan situasi apabila data pembolehubah memerlukan pemeriksaan data atribut.**

Differenciate between attribute and variable type of data, provide with suitable example of the data type. Describe the situation when variable type of data requires attribute data type inspection.

(20 markah)

S6. [a] **Apakah faktor-faktor yang perlu diambil kira dalam pemilihan kaedah pensampelan untuk menentukan kualiti sesebuah produk?**

What are the factors to be considered in selecting sampling procedure for determining quality of a product?

(20 markah)

[b] **Huraikan tiga jenis asas pelan pensampelan. Apakah kepentingan bagi AQL dari pandangan "producer's risk"?**

Describe the three basic type of sampling plans. What is the importance of AQL from producer's risk view point?

(30 markah)

[c] **Sebuah hospital memeriksa kualiti bagi produk boleh buang yang dibekalkan oleh syarikat yang menggunakan satu pelan pensampelan N = 8000, n = 62, dan c = 1. Bina satu lengkung OC dengan menggunakan sekurang-kurangnya 7 ciri penting.**

A hospital checks the quality of a disposable product supplied by a company using the single sampling plan N = 8000, n = 62, and c = 1. Construct an OC curve using at least seven points.

(50 markah)

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Factors for Computing Central Lines and 3σ Control Limits for $\bar{X}$,s and R Chart

OBSERVATIONS IN SAMPLE, n	CHART FOR AVERAGES			CHART FOR STANDARD DEVIATIONS					CHART FOR RANGES					
	FACTORS FOR CONTROL LIMITS			FACTOR FOR CENTRAL LINE	FACTORS FOR CONTROL LIMITS				FACTOR FOR CENTRAL LINE	FACTORS FOR CONTROL LIMITS				
	A	A_2	A_3	c_4	B_3	B_4	B_5	B_6	d_2	d_1	D_1	D_2	D_3	D_4
2	2.121	1.880	2.659	0.7979	0	3.267	0	2.606	1.128	0.853	0	3.686	0	3.267
3	1.732	1.023	1.954	0.8862	0	2.568	0	2.276	1.693	0.888	0	4.358	0	2.574
4	1.500	0.729	1.628	0.9213	0	2.266	0	2.088	2.059	0.880	0	4.698	0	2.282
5	1.342	0.577	1.427	0.9400	0	2.089	0	1.964	2.326	0.864	0	4.918	0	2.114
6	1.225	0.483	1.287	0.9515	0.030	1.970	0.029	1.874	2.534	0.848	0	5.078	0	2.004
7	1.134	0.419	1.182	0.9594	0.118	1.882	0.113	1.806	2.704	0.833	0.204	5.204	0.076	1.924
8	1.061	0.373	1.099	0.9650	0.185	1.815	0.179	1.751	2.847	0.820	0.388	5.306	0.136	1.864
9	1.000	0.337	1.032	0.9693	0.239	1.761	0.232	1.707	2.970	0.808	0.547	5.393	0.184	1.816
10	0.949	0.308	0.975	0.9727	0.284	1.716	0.276	1.669	3.078	0.797	0.687	5.469	0.223	1.777
11	0.905	0.285	0.927	0.9754	0.321	1.679	0.313	1.637	3.173	0.787	0.811	5.535	0.256	1.744
12	0.866	0.266	0.886	0.9776	0.354	1.646	0.346	1.610	3.258	0.778	0.922	5.594	0.283	1.717
13	0.832	0.249	0.850	0.9794	0.382	1.618	0.374	1.585	3.336	0.770	1.025	5.647	0.307	1.693
14	0.802	0.235	0.817	0.9810	0.406	1.594	0.399	1.563	3.407	0.763	1.118	5.696	0.328	1.672
15	0.775	0.223	0.789	0.9823	0.428	1.572	0.421	1.544	3.472	0.756	1.203	5.741	0.347	1.653
16	0.750	0.212	0.763	0.9835	0.448	1.552	0.440	1.526	3.532	0.750	1.282	5.782	0.363	1.637
17	0.728	0.203	0.739	0.9845	0.466	1.534	0.458	1.511	3.588	0.744	1.356	5.820	0.378	1.622
18	0.707	0.194	0.718	0.9854	0.482	1.518	0.475	1.496	3.640	0.739	1.424	5.856	0.391	1.608
19	0.688	0.187	0.698	0.9862	0.497	1.503	0.490	1.483	3.689	0.734	1.487	5.891	0.403	1.597
20	0.671	0.180	0.680	0.9869	0.510	1.490	0.504	1.470	3.735	0.729	1.549	5.921	0.415	1.585

The Poison Distribution $P(c)=\frac{(np_o)}{c!}e^{-np_o}$ **(Cumulative Values Are in Parentheses)**

c \ np_0	0.1	0.2	0.3	0.4	0.5
0	0.905 (0.905)	0.819 (0.819)	0.741 (0.741)	0.670 (0.670)	0.607 (0.607)
1	0.091 (0.996)	0.164 (0.983)	0.222 (0.963)	0.268 (0.938)	0.303 (0.910)
2	0.004 (1.000)	0.016 (0.999)	0.033 (0.996)	0.054 (0.992)	0.076 (0.986)
3		0.010 (1.000)	0.004 (1.000)	0.007 (0.999)	0.013 (0.999)
4				0.001 (1.000)	0.001 (1.000)

c \ np_0	0.6	0.7	0.8	0.9	1.0
0	0.549 (0.549)	0.497 (0.497)	0.449 (0.449)	0.406 (0.406)	0.368 (0.368)
1	0.329 (0.878)	0.349 (0.845)	0.359 (0.808)	0.366 (0.772)	0.368 (0.736)
2	0.099 (0.977)	0.122 (0.967)	0.144 (0.952)	0.166 (0.938)	0.184 (0.920)
3	0.020 (0.997)	0.028 (0.995)	0.039 (0.991)	0.049 (0.987)	0.061 (0.981)
4	0.003 (1.000)	0.005 (1.000)	0.008 (0.999)	0.011 (0.998)	0.016 (0.997)
5			0.001 (1.000)	0.002 (1.000)	0.003 (1.000)

c \ np_0	1.1	1.2	1.3	1.4	1.5
0	0.333 (0.333)	0.301 (0.301)	0.273 (0.273)	0.247 (0.247)	0.223 (0.223)
1	0.366 (0.699)	0.361 (0.662)	0.354 (0.627)	0.345 (0.592)	0.335 (0.558)
2	0.201 (0.900)	0.217 (0.879)	0.230 (0.857)	0.242 (0.834)	0.251 (0.809)
3	0.074 (0.974)	0.087 (0.966)	0.100 (0.957)	0.113 (0.947)	0.126 (0.935)
4	0.021 (0.995)	0.026 (0.992)	0.032 (0.989)	0.039 (0.986)	0.047 (0.982)
5	0.004 (0.999)	0.007 (0.999)	0.009 (0.998)	0.011 (0.997)	0.014 (0.996)
6	0.001 (1.000)	0.001 (1.000)	0.002 (1.000)	0.003 (1.000)	0.004 (1.000)

c \ np_0	1.6	1.7	1.8	1.9	2.0
0	0.202 (0.202)	0.183 (0.183)	0.165 (0.165)	0.150 (0.150)	0.135 (0.135)
1	0.323 (0.525)	0.311 (0.494)	0.298 (0.463)	0.284 (0.434)	0.271 (0.406)
2	0.258 (0.783)	0.264 (0.758)	0.268 (0.731)	0.270 (0.704)	0.271 (0.677)
3	0.138 (0.921)	0.149 (0.907)	0.161 (0.892)	0.171 (0.875)	0.180 (0.857)
4	0.055 (0.976)	0.064 (0.971)	0.072 (0.964)	0.081 (0.956)	0.090 (0.947)
5	0.018 (0.994)	0.022 (0.993)	0.026 (0.990)	0.031 (0.987)	0.036 (0.983)
6	0.005 (0.999)	0.006 (0.999)	0.008 (0.998)	0.010 (0.997)	0.012 (0.995)
7	0.001 (1.000)	0.001 (1.000)	0.002 (1.000)	0.003 (1.000)	0.004 (0.999)
8					0.001 (1.000)

Continued

TABLE C Continued

c \ np_0	2.1	2.2	2.3	2.4	2.5
0	0.123 (0.123)	0.111 (0.111)	0.100 (0.100)	0.091 (0.091)	0.082 (0.082)
1	0.257 (0.380)	0.244 (0.355)	0.231 (0.331)	0.218 (0.309)	0.205 (0.287)
2	0.270 (0.650)	0.268 (0.623)	0.265 (0.596)	0.261 (0.570)	0.256 (0.543)
3	0.189 (0.839)	0.197 (0.820)	0.203 (0.799)	0.209 (0.779)	0.214 (0.757)
4	0.099 (0.938)	0.108 (0.928)	0.117 (0.916)	0.125 (0.904)	0.134 (0.891)
5	0.042 (0.980)	0.048 (0.976)	0.054 (0.970)	0.060 (0.964)	0.067 (0.958)
6	0.015 (0.995)	0.017 (0.993)	0.021 (0.991)	0.024 (0.988)	0.028 (0.986)
7	0.004 (0.999)	0.005 (0.998)	0.007 (0.998)	0.008 (0.996)	0.010 (0.996)
8	0.001 (1.000)	0.002 (1.000)	0.002 (1.000)	0.003 (0.999)	0.003 (0.999)
9				0.001 (1.000)	0.001 (1.000)

c \ np_0	2.6	2.7	2.8	2.9	3.0
0	0.074 (0.074)	0.067 (0.067)	0.061 (0.061)	0.055 (0.055)	0.050 (0.050)
1	0.193 (0.267)	0.182 (0.249)	0.170 (0.231)	0.160 (0.215)	0.149 (0.199)
2	0.251 (0.518)	0.245 (0.494)	0.238 (0.469)	0.231 (0.446)	0.224 (0.423)
3	0.218 (0.736)	0.221 (0.715)	0.223 (0.692)	0.224 (0.670)	0.224 (0.647)
4	0.141 (0.877)	0.149 (0.864)	0.156 (0.848)	0.162 (0.832)	0.168 (0.815)
5	0.074 (0.951)	0.080 (0.944)	0.087 (0.935)	0.094 (0.926)	0.101 (0.916)
6	0.032 (0.983)	0.036 (0.980)	0.041 (0.976)	0.045 (0.971)	0.050 (0.966)
7	0.012 (0.995)	0.014 (0.994)	0.016 (0.992)	0.019 (0.990)	0.022 (0.988)
8	0.004 (0.999)	0.005 (0.999)	0.006 (0.998)	0.007 (0.997)	0.008 (0.996)
9	0.001 (1.000)	0.001 (1.000)	0.002 (1.000)	0.002 (0.999)	0.003 (0.999)
10				0.001 (1.000)	0.001 (1.000)

c \ np_0	3.1	3.2	3.3	3.4	3.5
0	0.045 (0.045)	0.041 (0.041)	0.037 (0.037)	0.033 (0.033)	0.030 (0.030)
1	0.140 (0.185)	0.130 (0.171)	0.122 (0.159)	0.113 (0.146)	0.106 (0.136)
2	0.216 (0.401)	0.209 (0.380)	0.201 (0.360)	0.193 (0.339)	0.185 (0.321)
3	0.224 (0.625)	0.223 (0.603)	0.222 (0.582)	0.219 (0.558)	0.216 (0.537)
4	0.173 (0.798)	0.178 (0.781)	0.182 (0.764)	0.186 (0.744)	0.189 (0.726)
5	0.107 (0.905)	0.114 (0.895)	0.120 (0.884)	0.126 (0.870)	0.132 (0.858)
6	0.056 (0.961)	0.061 (0.956)	0.066 (0.950)	0.071 (0.941)	0.077 (0.935)
7	0.025 (0.986)	0.028 (0.984)	0.031 (0.981)	0.035 (0.976)	0.038 (0.973)
8	0.010 (0.996)	0.011 (0.995)	0.012 (0.993)	0.015 (0.991)	0.017 (0.990)
9	0.003 (0.999)	0.004 (0.999)	0.005 (0.998)	0.006 (0.997)	0.007 (0.997)
10	0.001 (1.000)	0.001 (1.000)	0.002 (1.000)	0.002 (0.999)	0.002 (0.999)
11				0.001 (1.000)	0.001 (1.000)

Continued

TABLE C Continued

c \ np_0	3.6	3.7	3.8	3.9	4.0
0	0.027 (0.027)	0.025 (0.025)	0.022 (0.022)	0.020 (0.020)	0.018 (0.018)
1	0.098 (0.125)	0.091 (0.116)	0.085 (0.107)	0.079 (0.099)	0.073 (0.091)
2	0.177 (0.302)	0.169 (0.285)	0.161 (0.268)	0.154 (0.253)	0.147 (0.238)
3	0.213 (0.515)	0.209 (0.494)	0.205 (0.473)	0.200 (0.453)	0.195 (0.433)
4	0.191 (0.706)	0.193 (0.687)	0.194 (0.667)	0.195 (0.648)	0.195 (0.628)
5	0.138 (0.844)	0.143 (0.830)	0.148 (0.815)	0.152 (0.800)	0.157 (0.785)
6	0.083 (0.927)	0.088 (0.918)	0.094 (0.909)	0.099 (0.899)	0.104 (0.889)
7	0.042 (0.969)	0.047 (0.965)	0.051 (0.960)	0.055 (0.954)	0.060 (0.949)
8	0.019 (0.988)	0.022 (0.987)	0.024 (0.984)	0.027 (0.981)	0.030 (0.979)
9	0.008 (0.996)	0.009 (0.996)	0.010 (0.994)	0.012 (0.993)	0.013 (0.992)
10	0.003 (0.999)	0.003 (0.999)	0.004 (0.998)	0.004 (0.997)	0.005 (0.997)
11	0.001 (1.000)	0.001 (1.000)	0.001 (0.999)	0.002 (0.999)	0.002 (0.999)
12			0.001 (1.000)	0.001 (1.000)	0.001 (1.000)

c \ np_0	4.1	4.2	4.3	4.4	4.5
0	0.017 (0.017)	0.015 (0.015)	0.014 (0.014)	0.012 (0.012)	0.011 (0.011)
1	0.068 (0.085)	0.063 (0.078)	0.058 (0.072)	0.054 (0.066)	0.050 (0.061)
2	0.139 (0.224)	0.132 (0.210)	0.126 (0.198)	0.119 (0.185)	0.113 (0.174)
3	0.190 (0.414)	0.185 (0.395)	0.180 (0.378)	0.174 (0.359)	0.169 (0.343)
4	0.195 (0.609)	0.195 (0.590)	0.193 (0.571)	0.192 (0.551)	0.190 (0.533)
5	0.160 (0.769)	0.163 (0.753)	0.166 (0.737)	0.169 (0.720)	0.171 (0.704)
6	0.110 (0.879)	0.114 (0.867)	0.119 (0.856)	0.124 (0.844)	0.128 (0.832)
7	0.064 (0.943)	0.069 (0.936)	0.073 (0.929)	0.078 (0.922)	0.082 (0.914)
8	0.033 (0.976)	0.036 (0.972)	0.040 (0.969)	0.043 (0.965)	0.046 (0.960)
9	0.015 (0.991)	0.017 (0.989)	0.019 (0.988)	0.021 (0.986)	0.023 (0.983)
10	0.006 (0.997)	0.007 (0.996)	0.008 (0.996)	0.009 (0.995)	0.011 (0.994)
11	0.002 (0.999)	0.003 (0.999)	0.003 (0.999)	0.004 (0.999)	0.004 (0.998)
12	0.001 (1.000)	0.001 (1.000)	0.001 (1.000)	0.001 (1.000)	0.001 (0.999)
13					0.001 (1.000)

Continued

TABLE C Continued

c \ np_0	4.6	4.7	4.8	4.9	5.0
0	0.010 (0.010)	0.009 (0.009)	0.008 (0.008)	0.008 (0.008)	0.007 (0.007)
1	0.046 (0.056)	0.043 (0.052)	0.039 (0.047)	0.037 (0.045)	0.034 (0.041)
2	0.106 (0.162)	0.101 (0.153)	0.095 (0.142)	0.090 (0.135)	0.084 (0.125)
3	0.163 (0.325)	0.157 (0.310)	0.152 (0.294)	0.146 (0.281)	0.140 (0.265)
4	0.188 (0.513)	0.185 (0.495)	0.182 (0.476)	0.179 (0.460)	0.176 (0.441)
5	0.172 (0.685)	0.174 (0.669)	0.175 (0.651)	0.175 (0.635)	0.176 (0.617)
6	0.132 (0.817)	0.136 (0.805)	0.140 (0.791)	0.143 (0.778)	0.146 (0.763)
7	0.087 (0.904)	0.091 (0.896)	0.096 (0.887)	0.100 (0.878)	0.105 (0.868)
8	0.050 (0.954)	0.054 (0.950)	0.058 (0.945)	0.061 (0.939)	0.065 (0.933)
9	0.026 (0.980)	0.028 (0.978)	0.031 (0.976)	0.034 (0.973)	0.036 (0.969)
10	0.012 (0.992)	0.013 (0.991)	0.015 (0.991)	0.016 (0.989)	0.018 (0.987)
11	0.005 (0.997)	0.006 (0.997)	0.006 (0.997)	0.007 (0.996)	0.008 (0.995)
12	0.002 (0.999)	0.002 (0.999)	0.002 (0.999)	0.003 (0.999)	0.003 (0.998)
13	0.001 (1.000)	0.001 (1.000)	0.001 (1.000)	0.001 (1.000)	0.001 (0.999)
14					0.001 (1.000)

c \ np_0	6.0	7.0	8.0	9.0	10.0
0	0.002 (0.002)	0.001 (0.001)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
1	0.015 (0.017)	0.006 (0.007)	0.003 (0.003)	0.001 (0.001)	0.000 (0.000)
2	0.045 (0.062)	0.022 (0.029)	0.011 (0.014)	0.005 (0.006)	0.002 (0.002)
3	0.089 (0.151)	0.052 (0.081)	0.029 (0.043)	0.015 (0.021)	0.007 (0.009)
4	0.134 (0.285)	0.091 (0.172)	0.057 (0.100)	0.034 (0.055)	0.019 (0.028)
5	0.161 (0.446)	0.128 (0.300)	0.092 (0.192)	0.061 (0.116)	0.038 (0.066)
6	0.161 (0.607)	0.149 (0.449)	0.122 (0.314)	0.091 (0.091)	0.063 (0.129)
7	0.138 (0.745)	0.149 (0.598)	0.140 (0.454)	0.117 (0.324)	0.090 (0.219)
8	0.103 (0.848)	0.131 (0.729)	0.140 (0.594)	0.132 (0.456)	0.113 (0.332)
9	0.069 (0.917)	0.102 (0.831)	0.124 (0.718)	0.132 (0.588)	0.125 (0.457)
10	0.041 (0.958)	0.071 (0.902)	0.099 (0.817)	0.119 (0.707)	0.125 (0.582)
11	0.023 (0.981)	0.045 (0.947)	0.072 (0.889)	0.097 (0.804)	0.114 (0.696)
12	0.011 (0.992)	0.026 (0.973)	0.048 (0.937)	0.073 (0.877)	0.095 (0.791)
13	0.005 (0.997)	0.014 (0.987)	0.030 (0.967)	0.050 (0.927)	0.073 (0.864)
14	0.002 (0.999)	0.007 (0.994)	0.017 (0.984)	0.032 (0.959)	0.052 (0.916)
15	0.001 (1.000)	0.003 (0.997)	0.009 (0.993)	0.019 (0.978)	0.035 (0.951)
16		0.002 (0.999)	0.004 (0.997)	0.011 (0.989)	0.022 (0.973)
17		0.001 (1.000)	0.002 (0.999)	0.006 (0.995)	0.013 (0.986)
18			0.001 (1.000)	0.003 (0.998)	0.007 (0.993)
19				0.001 (0.999)	0.004 (0.997)
20				0.001 (1.000)	0.002 (0.999)
21					0.001 (1.000)

Continued

TABLE C Continued

c \ np_0	11.0	12.0	13.0	14.0	15.0
0	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
1	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
2	0.001 (0.001)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
3	0.004 (0.005)	0.002 (0.002)	0.001 (0.001)	0.000 (0.000)	0.000 (0.000)
4	0.010 (0.015)	0.005 (0.007)	0.003 (0.004)	0.001 (0.001)	0.001 (0.001)
5	0.022 (0.037)	0.013 (0.020)	0.007 (0.011)	0.004 (0.005)	0.002 (0.003)
6	0.041 (0.078)	0.025 (0.045)	0.015 (0.026)	0.009 (0.014)	0.005 (0.008)
7	0.065 (0.143)	0.044 (0.089)	0.028 (0.054)	0.017 (0.031)	0.010 (0.018)
8	0.089 (0.232)	0.066 (0.155)	0.046 (0.100)	0.031 (0.062)	0.019 (0.037)
9	0.109 (0.341)	0.087 (0.242)	0.066 (0.166)	0.047 (0.109)	0.032 (0.069)
10	0.119 (0.460)	0.105 (0.347)	0.086 (0.252)	0.066 (0.175)	0.049 (0.118)
11	0.119 (0.579)	0.114 (0.461)	0.101 (0.353)	0.084 (0.259)	0.066 (0.184)
12	0.109 (0.688)	0.114 (0.575)	0.110 (0.463)	0.099 (0.358)	0.083 (0.267)
13	0.093 (0.781)	0.106 (0.681)	0.110 (0.573)	0.106 (0.464)	0.096 (0.363)
14	0.073 (0.854)	0.091 (0.772)	0.102 (0.675)	0.106 (0.570)	0.102 (0.465)
15	0.053 (0.907)	0.072 (0.844)	0.088 (0.763)	0.099 (0.669)	0.102 (0.567)
16	0.037 (0.944)	0.054 (0.898)	0.072 (0.835)	0.087 (0.756)	0.096 (0.663)
17	0.024 (0.968)	0.038 (0.936)	0.055 (0.890)	0.071 (0.827)	0.085 (0.748)
18	0.015 (0.983)	0.026 (0.962)	0.040 (0.930)	0.056 (0.883)	0.071 (0.819)
19	0.008 (0.991)	0.016 (0.978)	0.027 (0.957)	0.041 (0.924)	0.056 (0.875)
20	0.005 (0.996)	0.010 (0.988)	0.018 (0.975)	0.029 (0.953)	0.042 (0.917)
21	0.002 (0.998)	0.006 (0.994)	0.011 (0.986)	0.019 (0.972)	0.030 (0.947)
22	0.001 (0.999)	0.003 (0.997)	0.006 (0.992)	0.012 (0.984)	0.020 (0.967)
23	0.001 (1.000)	0.002 (0.999)	0.004 (0.996)	0.007 (0.991)	0.013 (0.980)
24		0.001 (1.000)	0.002 (0.998)	0.004 (0.995)	0.008 (0.988)
25			0.001 (0.999)	0.003 (0.998)	0.005 (0.993)
26			0.001 (1.000)	0.001 (0.999)	0.003 (0.996)
27				0.001 (1.000)	0.002 (0.998)
28					0.001 (0.999)
29					0.001 (1.000)