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A STOCHASTIC MODEL FOR THE EVOLUTION OF
CLOUD COVER--ESTIMATION OF PARAMETERS
AND GOODNESS OF FIT BASED ON BOSTON DATA

by

Martin Fox and Herman Rubin

Michigan State University

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Bedford, Massachusetts

Contract No. AF19(628)- 355

Project No. 8624

Task No. 862402

FINAL REPORT

May 7, 1965

Prepared
for

AIR FORCE CAMBRIDGE RESEARCH LABORATORIES
OFFICE OF AEROSPACE RESEARCH
UNITED STATES AIR FORCE
BEDFORD, MASSACHUSETTS

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ABSTRACT

A stochastic model is proposed for the evolution of cloud cover. In this model each of the four observable states (clear, partially cloudy, cloudy, and overcast) is assumed to be the image under some function of two states of an eight state Markov chain. Estimates are given of transition probabilities in the observable four state process. Tables which allow assessment of the accuracy of the estimates and of the goodness of fit of the model are also provided.

1. Introduction. The purpose of the investigation under this contract has been to propose and test the fit of stochastic models for the behaviour of cloud cover. Several models, discussed in status reports, failed to fit the data. On the basis of work done by Fox [2] a model was proposed in which the observable stochastic process is some function f of a Markov chain. In the observable process, each state is assumed to be the image under f of two states in the Markov chain. Fox's work has been generalized by Dharmadhikari [1] and, hence, will not be published. The states in the observable process are:

1. Clear
2. Partially cloudy
3. Cloudy
4. Overcast

A preliminary goodness of fit test was carried out based on six hourly data for Boston for January. The computational method was proposed by Rubin and appears in [4] in an improved and generalized form. The preliminary goodness of fit tests indicated a good fit and work was undertaken on testing the model for the remainder of the year, still using Boston data. The following pages are a report on the outcome of these computations.

One other line of investigation was initiated by Fox [3]. He proposed a model for the behaviour of the fair weather cumulus component of cloud cover. Testing of the model requires data of a type not presently available. Fox mentions refinements in his model which appear needed if there is to be any hope of a reasonable fit.

Section 2 contains tables of estimated conditional probabilities of each of the four states for Boston at times six and twelve hours after the most recent observation given the states at the most recent observation and six or twelve hours previously. Separate tables are given for each month

and for the most recent observation at (i) midnight, (ii) 6 A.M., (iii) noon, and (iv) 6 P.M. Section 3 contains a discussion of the reliability of these estimates. Section 4 is a discussion of further research suggested by results obtained under this contract.

2. The conditional probabilities. Let X_n be the state observed at time n . We assume:

(i) $X_n = f(Y_n)$ where $\{Y_n\}$ is a Markov chain with eight states.

(ii) Each state of $\{X_n\}$ is the image of two states of $\{Y_n\}$.

(iii) The transition probabilities of $\{Y_n\}$ depend on month and time of day.

For any state c of $\{X_n\}$ let $p(AcB)$ be the conditional probability given that the present state is c , that the past was in the set A and the future will be in the state B . It follows from (iii) that $p(AcB)$ depends on the present month and time of day.

Let A_1, \dots, A_m be sets of pasts and B_1, \dots, B_n be sets of futures. It follows from (i) and (ii) that, for each i, j , we have

$$(2.1) \quad p(A_i c B_j) = \alpha_1(A_i, c) \beta_1(B_j, c) + \alpha_2(A_i, c) \beta_2(B_j, c)$$

for some nonnegative functions $\alpha_1, \alpha_2, \beta_1, \beta_2$. Hence the matrix

$$\begin{pmatrix} p(A_1 c B_1) & \dots & p(A_1 c B_n) \\ \vdots & & \vdots \\ p(A_m c B_1) & \dots & p(A_m c B_n) \end{pmatrix}$$

is of rank at most 2. Dharmadhikari's work shows that assuming this matrix is of rank 2 implies (i), (ii), and (iii), above. If $\{X_n\}$ were Markovian, this matrix would be of rank 1. We have considered the following eight sets of pasts:

A_1 : Clear six hours ago;

A_2 : Partially cloudy six hours ago;

A_3 : Cloudy six hours ago;

A_4 : Overcast six hours ago;

A_5 : Clear twelve hours ago;

A_6 : Partially cloudy twelve hours ago;

A_7 : Cloudy twelve hours ago;

A_8 : Overcast twelve hours ago;

and the eight sets of futures:

B_1 : Clear six hours in the future;

B_2 : Partially cloudy six hours in the future;

B_3 : Cloudy six hours in the future;

B_4 : Overcast six hours in the future;

B_5 : Clear twelve hours in the future;

B_6 : Partially cloudy twelve hours in the future;

B_7 : Cloudy twelve hours in the future;

B_8 : Overcast twelve hours in the future.

For brevity, let $p_{1j} = p(A_1, c, B_j)$ and let n_{1j} be the number of times we observe at this hour in this month the state c preceded by a sequence of states in A_1 and followed by a sequence of states in B_j . We estimate the p_{1j} by the method of maximum likelihood. That is, subject to (2.1) we maximize

$$(2.2) \quad \prod_{i=1}^8 \prod_{j=1}^8 p_{1j}^{n_{1j}}.$$

The computations were performed on the CDC 3600 at Michigan State University. Newton's method was used. This requires setting an initial approximation to the solution and iteratively improving upon it. This must be done for each month, time of day (midnight, 6A.M., noon, 6P.M.) and each of the four states considered as the present state. The iterations are continued until two successive iterations yield the same answers.

Having estimated the p_{1j} we now wish to estimate the conditional probability that the future will be in B_j given that the past was in A_1 and the present is c . Since B_1, B_2, B_3, B_4 are mutually exclusive

and exhaustive, $q_1 = \sum_{j=1}^4 p_{1j}$ is the probability that the present state is c and the past state was in A_1 . Hence p_{1j}/q_1 is the conditional probability that the future will be in B_j given the present state is c and the past was in A_1 . Using the estimates of the p_{1j} yields estimates of the conditional probabilities.

The data used are for Boston for March, 1945 to November, 1961.

Tables 2.1 to 2.48 give the desired estimates of conditional probabilities. Separate tables are given for each month and time of day.

The states are numbered as follows:

State 1: Clear

State 2: Partially cloudy

State 3: Cloudy

State 4: Overcast

No estimates are given of conditional probabilities for July given state 4 at noon and state 1 six hours earlier. Such estimates cannot be given since these conditions never occurred in Boston during a July in the period covered by the data.

We now consider examples to show how the table may be used. Suppose it is January and the most recent observation was at midnight. At that time assume the sky was partially cloudy and that six hours earlier the sky was cloudy. Refer to the upper half of Table 2.1. Entering the table with Present State 2 and State 3 Six Hours Earlier we read in the first four states at 6A.M. following from the first four columns. These are:

State	Estimated Probability
1	.326
2	.245
3	.129
4	.300

If, instead, we wish these estimates for noon following we read from the last four columns as follows:

State	Estimated Probability
1	.258
2	.216
3	.150
4	.376

If we do not know the state six hours earlier but do know it twelve hours earlier (preceeding noon) we use the bottom half of Table 2.1. Suppose it was partially cloudy at midnight and clear the preceeding noon. The estimates for the 6A.M. following are:

State	Estimated Probability
1	.181
2	.176
3	.212
4	.431

and for the noon following are:

State	Estimated Probability
1	.121
2	.105
3	.070
4	.704

The values of the functions α_1 , α_2 , β_1 , and β_2 are exemplified in Table 2.49. The values given are for January, present state 1. The values of β_1 and β_2 are normalized so as to be the conditional probabilities of the stated future of the observable process given, that the present state of the Markov chain is, respectively, δ_1 and δ_2 . Here δ_1 and δ_2 are the two states whose image under the function f is the state 1 of the observable process. The functions α_1 and α_2 are then, the conditional probabilities that the Markov chain is in state δ_1 and δ_2 .

respectively, given the stated past and that the present is in state 1.

It should be noted that the values given in Table 2.49 are not unique. It is possible to find other values which satisfy (2.1), are nonnegative, and are normalized as stated in the preceding paragraph.

The following section indicates how one might gauge the reliability of these estimates. Tables are provided to make this possible.

Tables 2.1 to 2.49 follow.

Table 2.1

Month: January

Time: Midnight

State 6 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.599	.164	.144	.093	.211	.295	.158	.336
2	1	.561	.120	.170	.149	.459	.128	.155	.258
3	1	.566	.127	.166	.141	.422	.153	.155	.270
4	1	.559	.118	.171	.152	.470	.121	.154	.255
1	2	.251	.210	.172	.367	.188	.160	.110	.542
2	2	.390	.275	.093	.242	.317	.264	.185	.234
3	2	.326	.245	.129	.300	.258	.216	.150	.376
4	2	.497	.326	.032	.145	.415	.342	.242	.001
1	3	.143	.156	.137	.564	.108	.133	.126	.633
2	3	.143	.144	.128	.585	.084	.151	.097	.668
3	3	.143	.167	.145	.545	.129	.117	.151	.603
4	3	.143	.181	.156	.520	.157	.097	.183	.563
1	4	.088	.038	.105	.769	.125	.140	.149	.586
2	4	.141	.030	.077	.752	.131	.181	.252	.436
3	4	.000	.052	.152	.796	.116	.082	.000	.802
4	4	.067	.041	.116	.776	.123	.125	.110	.642

State 12 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.590	.154	.150	.106	.266	.258	.157	.319
2	1	.584	.146	.155	.115	.310	.229	.156	.305
3	1	.585	.148	.154	.113	.298	.237	.157	.308
4	1	.569	.130	.164	.137	.402	.166	.156	.276
1	2	.181	.176	.212	.431	.121	.105	.070	.704
2	2	.318	.241	.134	.307	.251	.210	.146	.393
3	2	.498	.326	.031	.145	.415	.342	.243	.000
4	2	.442	.300	.063	.195	.364	.301	.213	.122
1	3	.144	.105	.099	.652	.000	.213	.000	.787
2	3	.141	.261	.215	.383	.288	.000	.337	.375
3	3	.143	.189	.162	.506	.171	.087	.199	.543
4	3	.143	.147	.131	.579	.091	.146	.106	.657
1	4	.045	.045	.128	.782	.120	.110	.072	.698
2	4	.054	.043	.123	.780	.121	.116	.088	.675
3	4	.113	.034	.092	.761	.128	.159	.196	.517
4	4	.070	.041	.115	.774	.123	.127	.115	.635

Table 2.2

Month: January

Time: Six A.M.

State 6 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.405	.280	.156	.158	.485	.154	.136	.225
2	1	.613	.282	.105	.000	.735	.123	.142	.000
3	1	.274	.273	.191	.266	.318	.175	.132	.375
4	1	.445	.211	.146	.128	.532	.148	.137	.183
1	2	.251	.251	.269	.229	.123	.189	.181	.507
2	2	.316	.249	.182	.203	.346	.106	.169	.379
3	2	.209	.250	.233	.218	.215	.155	.176	.454
4	2	.509	.246	.074	.171	.630	.000	.155	.215
1	3	.059	.090	.126	.685	.195	.061	.129	.615
2	3	.000	.053	.106	.841	.096	.000	.134	.770
3	3	.185	.121	.144	.550	.279	.112	.125	.484
4	3	.406	.203	.191	.200	.486	.238	.115	.161
1	4	.171	.180	.047	.602	.329	.080	.221	.370
2	4	.000	.059	.128	.813	.105	.104	.068	.723
3	4	.030	.080	.114	.776	.143	.100	.093	.664
4	4	.041	.088	.109	.762	.156	.098	.103	.643

State 12 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.303	.279	.182	.236	.364	.169	.133	.334
2	1	.529	.282	.125	.064	.633	.136	.139	.092
3	1	.514	.281	.129	.076	.615	.138	.139	.108
4	1	.537	.282	.123	.058	.643	.135	.140	.082
1	2	.273	.251	.252	.224	.165	.174	.178	.483
2	2	.187	.253	.317	.243	.000	.235	.187	.578
3	2	.450	.248	.118	.184	.512	.044	.161	.283
4	2	.417	.248	.144	.191	.446	.069	.164	.321
1	3	.068	.078	.120	.734	.164	.042	.131	.663
2	3	.157	.111	.138	.594	.252	.095	.126	.527
3	3	.068	.079	.120	.733	.165	.042	.131	.662
4	3	.411	.205	.192	.192	.491	.241	.115	.153
1	4	.064	.104	.098	.734	.185	.095	.123	.597
2	4	.084	.119	.088	.709	.212	.092	.141	.555
3	4	.073	.110	.094	.723	.197	.094	.131	.578
4	4	.035	.083	.112	.770	.149	.099	.098	.654

Table 2.3

Month: January

Time: Noon

State 6 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.713	.087	.091	.109	.514	.145	.063	.278
2	1	.586	.102	.142	.170	.436	.117	.100	.347
3	1	.798	.077	.057	.068	.566	.164	.039	.231
4	1	.563	.105	.151	.181	.421	.112	.107	.360
1	2	.505	.173	.136	.186	.510	.102	.075	.313
2	2	.212	.094	.326	.368	.242	.074	.136	.548
3	2	.554	.186	.104	.156	.551	.107	.065	.277
4	2	.466	.162	.161	.211	.476	.099	.082	.343
1	3	.323	.284	.132	.261	.380	.121	.169	.330
2	3	.135	.178	.139	.548	.182	.058	.094	.666
3	3	.223	.228	.136	.413	.281	.089	.132	.498
4	3	.312	.278	.133	.277	.370	.118	.165	.347
1	4	.105	.169	.190	.536	.289	.035	.047	.629
2	4	.080	.094	.126	.700	.212	.061	.092	.635
3	4	.097	.144	.169	.590	.264	.044	.061	.631
4	4	.070	.064	.099	.767	.181	.072	.110	.637

State 12 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.632	.097	.123	.148	.464	.127	.087	.322
2	1	.939	.061	.000	.000	.649	.194	.000	.157
3	1	.939	.061	.000	.000	.649	.194	.000	.157
4	1	.656	.094	.114	.136	.479	.133	.080	.308
1	2	.378	.139	.218	.265	.398	.091	.100	.411
2	2	.365	.135	.227	.273	.387	.089	.103	.421
3	2	.163	.081	.358	.398	.194	.069	.147	.590
4	2	.623	.205	.059	.113	.608	.113	.052	.227
1	3	.279	.259	.134	.328	.338	.108	.153	.401
2	3	.000	.101	.145	.754	.000	.001	.026	.973
3	3	.282	.261	.134	.323	.341	.109	.154	.396
4	3	.326	.386	.132	.256	.383	.122	.170	.325
1	4	.102	.159	.182	.557	.279	.039	.053	.629
2	4	.083	.103	.133	.681	.221	.059	.086	.634
3	4	.077	.084	.116	.723	.201	.065	.098	.636
4	4	.069	.063	.099	.769	.180	.073	.110	.637

Table 2.4

Month: January

Time: Six P.M.

State 6 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.610	.139	.066	.176	.470	.156	.142	.232
2	1	.629	.156	.056	.159	.473	.164	.148	.215
3	1	.609	.123	.076	.192	.466	.150	.137	.247
4	1	.588	.088	.098	.226	.459	.135	.125	.281
1	2	.332	.254	.000	.414	.163	.083	.082	.672
2	2	.435	.087	.223	.255	.352	.165	.124	.359
3	2	.408	.130	.166	.296	.301	.143	.113	.443
4	2	.446	.069	.247	.238	.373	.174	.129	.324
1	3	.348	.000	.252	.400	.185	.106	.221	.488
2	3	.339	.090	.213	.358	.253	.112	.136	.499
3	3	.348	.000	.252	.400	.185	.106	.221	.488
4	3	.331	.178	.175	.316	.323	.119	.048	.510
1	4	.166	.000	.000	.834	.000	.068	.442	.490
2	4	.120	.049	.052	.779	.120	.062	.171	.647
3	4	.090	.080	.086	.744	.196	.058	.000	.746
4	4	.111	.058	.062	.769	.143	.060	.120	.677

State 12 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.629	.156	.056	.159	.473	.164	.147	.216
2	1	.533	.000	.153	.314	.441	.098	.096	.365
3	1	.685	.245	.000	.070	.492	.202	.178	.128
4	1	.580	.077	.105	.238	.457	.130	.121	.292
1	2	.372	.189	.087	.352	.234	.114	.099	.553
2	2	.407	.133	.162	.298	.298	.142	.113	.447
3	2	.489	.000	.339	.172	.456	.210	.148	.186
4	2	.430	.095	.212	.263	.342	.161	.122	.375
1	3	.342	.062	.225	.371	.231	.110	.163	.496
2	3	.348	.000	.252	.400	.185	.106	.221	.488
3	3	.348	.001	.251	.400	.185	.106	.220	.489
4	3	.332	.162	.182	.324	.310	.118	.064	.508
1	4	.135	.032	.035	.798	.080	.064	.262	.594
2	4	.125	.043	.046	.786	.105	.063	.205	.627
3	4	.105	.064	.069	.762	.157	.060	.087	.696
4	4	.108	.061	.065	.766	.149	.060	.106	.685

Table 2.5

Month: February

Time: Midnight

State 6 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.609	.151	.154	.086	.312	.195	.186	.307
2	1	.521	.197	.196	.086	.275	.215	.209	.301
3	1	.282	.322	.309	.087	.178	.268	.271	.283
4	1	.515	.200	.199	.086	.272	.216	.211	.301
1	2	.221	.209	.220	.350	.260	.236	.219	.285
2	2	.133	.182	.268	.417	.154	.247	.259	.340
3	2	.244	.216	.207	.333	.289	.233	.208	.270
4	2	.334	.258	.131	.227	.472	.213	.139	.176
1	3	.000	.000	.355	.645	.099	.123	.157	.621
2	3	.293	.223	.230	.249	.203	.229	.285	.283
3	3	.388	.302	.189	.121	.239	.267	.330	.164
4	3	.261	.203	.244	.292	.191	.217	.270	.322
1	4	.000	.066	.105	.829	.025	.131	.229	.615
2	4	.002	.067	.105	.826	.028	.130	.227	.615
3	4	.144	.088	.098	.670	.240	.034	.104	.622
4	4	.047	.073	.103	.777	.095	.099	.188	.618

State 12 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.648	.131	.135	.086	.328	.186	.176	.310
2	1	.602	.155	.157	.086	.309	.196	.188	.307
3	1	.504	.205	.204	.087	.266	.219	.214	.299
4	1	.400	.260	.253	.087	.225	.242	.241	.292
1	2	.000	.141	.341	.518	.000	.263	.318	.419
2	2	.239	.230	.182	.299	.347	.227	.186	.240
3	2	.201	.202	.231	.366	.235	.238	.229	.298
4	2	.345	.246	.152	.257	.419	.219	.159	.203
1	3	.174	.135	.231	.410	.159	.184	.231	.426
2	3	.154	.120	.289	.437	.152	.177	.222	.449
3	3	.272	.212	.239	.277	.195	.221	.275	.309
4	3	.261	.203	.243	.293	.191	.216	.270	.323
1	4	.093	.080	.101	.726	.164	.068	.148	.620
2	4	.000	.066	.105	.829	.025	.131	.229	.615
3	4	.074	.077	.102	.747	.135	.081	.165	.619
4	4	.049	.073	.103	.775	.097	.098	.187	.618

Table 2.6

Month: February

Time: Six A.M.

State 6 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.428	.212	.158	.202	.441	.207	.118	.234
2	1	.504	.161	.335	.000	.438	.286	.276	.000
3	1	.463	.185	.251	.096	.439	.250	.203	.108
4	1	.471	.183	.257	.089	.439	.252	.208	.101
1	2	.126	.251	.303	.320	.335	.101	.172	.392
2	2	.460	.227	.313	.000	.413	.204	.221	.157
3	2	.336	.236	.309	.119	.390	.169	.205	.236
4	2	.460	.227	.313	.000	.418	.204	.222	.156
1	3	.148	.164	.344	.344	.246	.159	.052	.543
2	3	.111	.298	.133	.458	.260	.177	.185	.378
3	3	.121	.261	.192	.426	.256	.172	.148	.424
4	3	.104	.321	.098	.477	.262	.180	.208	.350
1	4	.101	.174	.147	.578	.295	.159	.111	.435
2	4	.109	.185	.144	.562	.310	.157	.105	.428
3	4	.043	.093	.170	.704	.172	.174	.155	.499
4	4	.033	.066	.174	.727	.149	.177	.163	.511

State 12 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.411	.223	.117	.249	.442	.188	.079	.291
2	1	.477	.179	.270	.074	.439	.258	.220	.083
3	1	.473	.182	.262	.083	.439	.255	.213	.093
4	1	.463	.188	.239	.110	.440	.244	.191	.125
1	2	.046	.257	.300	.397	.312	.071	.158	.459
2	2	.273	.241	.307	.179	.375	.150	.196	.279
3	2	.329	.237	.309	.125	.388	.167	.204	.241
4	2	.384	.233	.310	.073	.401	.183	.212	.204
1	3	.146	.169	.337	.348	.246	.160	.056	.538
2	3	.124	.251	.207	.418	.255	.171	.138	.436
3	3	.129	.233	.235	.403	.253	.168	.121	.458
4	3	.108	.308	.117	.467	.261	.178	.196	.365
1	4	.073	.129	.158	.640	.235	.167	.132	.466
2	4	.047	.089	.168	.696	.179	.174	.152	.495
3	4	.039	.076	.171	.714	.162	.176	.158	.504
4	4	.038	.075	.172	.715	.161	.176	.159	.504

Table 2.7

Month: February

Time: Noon

State 6 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.624	.210	.124	.042	.614	.045	.108	.233
2	1	.626	.222	.107	.045	.603	.090	.106	.201
3	1	.640	.301	.000	.059	.530	.376	.094	.000
4	1	.640	.301	.000	.059	.530	.376	.094	.000
1	2	.433	.212	.209	.146	.331	.129	.117	.423
2	2	.446	.225	.153	.170	.384	.125	.085	.406
3	2	.479	.264	.000	.257	.525	.115	.000	.360
4	2	.458	.240	.096	.206	.436	.122	.053	.389
1	3	.274	.242	.197	.287	.394	.099	.164	.303
2	3	.281	.238	.204	.277	.414	.104	.172	.310
3	3	.213	.277	.139	.371	.217	.047	.100	.636
4	3	.301	.227	.223	.249	.473	.121	.193	.213
1	4	.079	.063	.158	.700	.136	.114	.060	.690
2	4	.079	.060	.157	.704	.131	.115	.061	.693
3	4	.079	.050	.155	.716	.115	.119	.062	.704
4	4	.079	.140	.174	.607	.253	.084	.051	.612

State 12 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.630	.243	.079	.048	.584	.165	.103	.148
2	1	.625	.213	.119	.043	.611	.057	.108	.224
3	1	.629	.242	.081	.048	.585	.161	.103	.151
4	1	.627	.225	.103	.045	.600	.100	.106	.194
1	2	.428	.206	.231	.135	.311	.130	.129	.430
2	2	.479	.264	.000	.257	.525	.115	.000	.360
3	2	.479	.264	.000	.257	.525	.115	.000	.360
4	2	.467	.249	.058	.226	.471	.119	.032	.378
1	3	.227	.268	.153	.352	.257	.059	.114	.570
2	3	.302	.226	.224	.248	.476	.122	.194	.208
3	3	.326	.213	.246	.215	.545	.143	.219	.093
4	3	.295	.230	.217	.258	.455	.116	.186	.243
1	4	.079	.023	.149	.749	.075	.129	.065	.731
2	4	.080	.200	.186	.534	.346	.060	.044	.550
3	4	.080	.183	.183	.554	.320	.067	.046	.567
4	4	.079	.131	.172	.618	.239	.088	.052	.621

Table 2.8

Month: February

Time: Six P.M.

State 6 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.685	.117	.078	.120	.440	.155	.175	.230
2	1	.650	.119	.079	.152	.469	.146	.114	.271
3	1	.722	.115	.078	.085	.408	.166	.240	.186
4	1	.709	.116	.078	.097	.419	.162	.217	.202
1	2	.307	.211	.250	.232	.067	.148	.210	.575
2	2	.564	.061	.000	.375	.436	.122	.160	.282
3	2	.404	.155	.156	.285	.217	.138	.190	.455
4	2	.491	.104	.071	.334	.341	.129	.173	.357
1	3	.281	.000	.352	.367	.385	.196	.161	.258
2	3	.289	.194	.127	.390	.253	.216	.187	.344
3	3	.235	.107	.228	.380	.311	.207	.176	.306
4	3	.294	.302	.000	.404	.181	.228	.201	.390
1	4	.000	.044	.067	.889	.052	.081	.029	.838
2	4	.038	.045	.068	.849	.080	.085	.064	.771
3	4	.172	.048	.071	.709	.134	.103	.194	.519
4	4	.089	.046	.069	.796	.118	.092	.112	.678

State 12 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.646	.119	.079	.156	.473	.145	.106	.276
2	1	.660	.118	.079	.143	.460	.149	.132	.259
3	1	.675	.118	.078	.129	.448	.153	.158	.241
4	1	.779	.113	.077	.031	.360	.181	.341	.118
1	2	.418	.146	.142	.294	.239	.136	.187	.438
2	2	.374	.172	.185	.269	.173	.141	.196	.490
3	2	.428	.141	.132	.299	.253	.135	.185	.427
4	2	.483	.109	.079	.329	.329	.130	.175	.366
1	3	.287	.130	.200	.383	.295	.210	.179	.316
2	3	.288	.155	.172	.385	.279	.212	.182	.327
3	3	.294	.302	.000	.404	.181	.228	.201	.390
4	3	.292	.236	.077	.395	.224	.221	.193	.362
1	4	.027	.044	.068	.861	.072	.084	.053	.791
2	4	.142	.048	.071	.739	.161	.099	.165	.575
3	4	.000	.044	.067	.889	.052	.081	.029	.838
4	4	.123	.047	.070	.760	.145	.096	.145	.614

Table 2.9

Month: March

Time: Midnight

State 6 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.540	.207	.167	.086	.416	.183	.164	.237
2	1	.430	.175	.221	.174	.270	.294	.231	.205
3	1	.536	.206	.169	.089	.411	.187	.166	.236
4	1	.518	.201	.178	.103	.388	.204	.177	.231
1	2	.211	.170	.255	.364	.173	.338	.177	.312
2	2	.461	.295	.132	.112	.220	.248	.355	.177
3	2	.156	.143	.282	.419	.164	.356	.141	.339
4	2	.325	.227	.199	.249	.194	.298	.255	.253
1	3	.249	.151	.166	.434	.149	.109	.217	.525
2	3	.000	.153	.347	.500	.000	.068	.154	.778
3	3	.159	.152	.231	.458	.097	.095	.196	.612
4	3	.478	.149	.000	.323	.267	.143	.267	.323
1	4	.071	.129	.144	.656	.102	.050	.234	.614
2	4	.057	.000	.059	.884	.072	.163	.119	.646
3	4	.067	.087	.116	.730	.092	.088	.195	.625
4	4	.067	.093	.120	.720	.093	.083	.200	.624

State 12 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.465	.185	.204	.146	.316	.259	.210	.215
2	1	.516	.200	.179	.105	.384	.207	.179	.230
3	1	.568	.215	.153	.064	.454	.155	.146	.245
4	1	.526	.203	.174	.097	.398	.197	.172	.233
1	2	.150	.140	.285	.425	.163	.358	.137	.342
2	2	.171	.150	.275	.404	.166	.351	.151	.332
3	2	.272	.201	.225	.302	.184	.317	.218	.281
4	2	.361	.246	.181	.212	.201	.285	.281	.233
1	3	.044	.153	.315	.488	.028	.075	.166	.731
2	3	.086	.153	.284	.477	.054	.083	.177	.686
3	3	.110	.152	.267	.471	.069	.087	.183	.661
4	3	.391	.150	.063	.396	.224	.130	.250	.396
1	4	.077	.181	.179	.563	.115	.000	.284	.601
2	4	.057	.000	.059	.884	.072	.163	.119	.646
3	4	.069	.108	.130	.693	.097	.069	.214	.620
4	4	.066	.087	.116	.731	.092	.088	.195	.625

Table 2.10

Month: March

Time: Six A.M.

State 6 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.541	.239	.158	.062	.464	.200	.128	.208
2	1	.408	.272	.183	.137	.351	.157	.229	.263
3	1	.340	.289	.196	.175	.293	.134	.282	.291
4	1	.426	.267	.180	.127	.367	.163	.215	.255
1	2	.236	.223	.237	.304	.208	.249	.315	.228
2	2	.235	.239	.217	.309	.176	.259	.349	.216
3	2	.245	.140	.335	.280	.369	.199	.147	.285
4	2	.246	.132	.345	.277	.385	.194	.130	.291
1	3	.164	.197	.246	.393	.328	.126	.140	.406
2	3	.355	.302	.343	.000	.251	.448	.096	.205
3	3	.116	.170	.223	.491	.358	.000	.157	.485
4	3	.198	.216	.264	.322	.309	.204	.130	.357
1	4	.119	.024	.143	.714	.065	.170	.302	.463
2	4	.000	.081	.171	.748	.107	.101	.137	.655
3	4	.010	.077	.168	.745	.103	.107	.151	.639
4	4	.022	.071	.166	.741	.099	.113	.117	.621

State 12 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.517	.245	.162	.076	.444	.193	.146	.217
2	1	.492	.251	.167	.090	.422	.184	.166	.228
3	1	.651	.212	.137	.000	.557	.236	.045	.162
4	1	.356	.285	.193	.166	.306	.139	.270	.285
1	2	.236	.228	.231	.305	.199	.252	.325	.224
2	2	.241	.176	.293	.290	.301	.220	.218	.261
3	2	.230	.282	.167	.321	.089	.286	.440	.185
4	2	.248	.108	.374	.270	.430	.180	.083	.307
1	3	.185	.208	.257	.350	.316	.175	.134	.375
2	3	.116	.170	.223	.491	.358	.000	.157	.485
3	3	.182	.207	.255	.356	.318	.168	.134	.380
4	3	.201	.218	.265	.316	.308	.209	.129	.354
1	4	.168	.000	.131	.701	.047	.200	.372	.381
2	4	.000	.081	.171	.748	.106	.101	.138	.655
3	4	.032	.066	.163	.739	.096	.119	.180	.605
4	4	.018	.073	.166	.743	.100	.111	.162	.627

Table 2.11

Month: March

Time: Noon

State 6 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.559	.220	.144	.077	.546	.098	.144	.212
2	1	.611	.213	.117	.059	.662	.048	.121	.169
3	1	.600	.214	.123	.063	.635	.059	.127	.179
4	1	.354	.246	.252	.148	.186	.254	.215	.345
1	2	.376	.279	.129	.216	.492	.027	.172	.309
2	2	.392	.268	.126	.214	.489	.050	.158	.303
3	2	.513	.185	.106	.196	.469	.223	.050	.258
4	2	.357	.292	.132	.219	.495	.000	.189	.316
1	3	.188	.174	.346	.292	.329	.110	.125	.436
2	3	.198	.166	.348	.288	.341	.121	.122	.416
3	3	.184	.176	.346	.294	.325	.107	.126	.442
4	3	.252	.128	.355	.265	.405	.175	.104	.316
1	4	.208	.000	.113	.679	.179	.125	.238	.458
2	4	.132	.110	.137	.721	.132	.092	.094	.682
3	4	.136	.045	.123	.696	.160	.112	.180	.548
4	4	.034	.109	.137	.720	.133	.092	.096	.679

State 12 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.538	.222	.156	.084	.502	.117	.153	.228
2	1	.592	.215	.127	.066	.618	.067	.130	.185
3	1	.438	.235	.208	.119	.317	.197	.189	.297
4	1	.656	.207	.093	.044	.772	.000	.100	.128
1	2	.405	.259	.124	.212	.487	.070	.145	.298
2	2	.357	.292	.132	.219	.495	.000	.189	.316
3	2	.570	.146	.097	.187	.460	.303	.000	.237
4	2	.357	.292	.132	.219	.495	.000	.189	.316
1	3	.163	.191	.343	.303	.301	.086	.133	.480
2	3	.133	.212	.339	.316	.266	.057	.142	.535
3	3	.342	.064	.367	.227	.512	.266	.074	.148
4	3	.227	.146	.351	.276	.375	.150	.112	.363
1	4	.103	.066	.127	.704	.151	.105	.153	.590
2	4	.000	.130	.141	.729	.123	.086	.067	.724
3	4	.057	.094	.134	.715	.139	.097	.115	.649
4	4	.046	.102	.135	.717	.136	.094	.106	.664

Table 2.12

Month: March

Time: Six P.M.

State 6 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.778	.062	.092	.068	.421	.180	.194	.205
2	1	.746	.068	.094	.092	.431	.192	.192	.185
3	1	.727	.072	.096	.105	.437	.200	.190	.173
4	1	.457	.124	.112	.307	.523	.308	.169	.000
1	2	.353	.167	.179	.301	.144	.216	.193	.447
2	2	.455	.083	.139	.323	.339	.110	.149	.402
3	2	.382	.144	.167	.307	.200	.185	.181	.434
4	2	.439	.096	.145	.320	.309	.126	.156	.409
1	3	.117	.182	.242	.459	.213	.095	.251	.441
2	3	.147	.182	.227	.444	.216	.101	.247	.436
3	3	.356	.184	.124	.336	.239	.142	.222	.397
4	3	.178	.182	.212	.428	.220	.107	.243	.430
1	4	.201	.075	.116	.608	.214	.000	.072	.714
2	4	.201	.075	.116	.603	.214	.000	.072	.714
3	4	.069	.071	.105	.755	.143	.185	.101	.621
4	4	.071	.071	.106	.752	.144	.133	.101	.622

State 12 hours later	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.776	.063	.092	.069	.422	.180	.104	.204
2	1	.760	.066	.093	.081	.427	.187	.193	.193
3	1	.704	.076	.097	.123	.445	.209	.188	.158
4	1	.638	.089	.101	.172	.466	.235	.183	.116
1	2	.439	.096	.145	.320	.310	.126	.156	.408
2	2	.480	.062	.129	.329	.388	.083	.138	.391
3	2	.322	.193	.191	.294	.083	.249	.207	.461
4	2	.390	.137	.164	.309	.216	.177	.177	.430
1	3	.099	.182	.250	.469	.212	.091	.253	.444
2	3	.359	.184	.122	.335	.239	.143	.222	.396
3	3	.301	.183	.151	.365	.233	.131	.229	.407
4	3	.244	.183	.179	.394	.226	.120	.236	.418
1	4	.154	.074	.112	.660	.189	.049	.082	.680
2	4	.000	.068	.100	.832	.108	.202	.116	.574
3	4	.166	.074	.113	.647	.195	.037	.080	.688
4	4	.061	.070	.105	.764	.139	.143	.103	.615

Table 2.13

Month: April

Time: Midnight

State 6 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.395	.265	.246	.094	.221	.194	.345	.240
2	1	.474	.161	.107	.258	.321	.177	.237	.265
3	1	.509	.115	.046	.330	.364	.170	.191	.275
4	1	.349	.325	.326	.000	.160	.204	.411	.225
1	2	.000	.202	.439	.359	.000	.294	.220	.486
2	2	.232	.317	.204	.247	.216	.167	.257	.360
3	2	.256	.330	.179	.235	.239	.154	.260	.347
4	2	.304	.353	.131	.212	.281	.129	.267	.323
1	3	.198	.194	.393	.215	.190	.215	.421	.174
2	3	.256	.075	.261	.408	.123	.201	.247	.429
3	3	.257	.074	.260	.409	.123	.200	.246	.431
4	3	.216	.156	.352	.276	.169	.211	.365	.255
1	4	.173	.164	.185	.478	.195	.240	.185	.380
2	4	.000	.000	.061	.939	.000	.000	.162	.838
3	4	.103	.098	.134	.665	.123	.151	.176	.550
4	4	.064	.060	.106	.770	.079	.096	.171	.654

State 12 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.447	.197	.155	.201	.287	.183	.274	.256
2	1	.425	.226	.193	.156	.260	.188	.303	.249
3	1	.480	.153	.097	.270	.328	.176	.229	.267
4	1	.419	.233	.203	.145	.252	.189	.311	.248
1	2	.034	.244	.354	.318	.080	.247	.234	.439
2	2	.133	.268	.304	.295	.127	.220	.241	.412
3	2	.301	.352	.134	.213	.278	.130	.267	.325
4	2	.316	.360	.118	.206	.292	.122	.269	.317
1	3	.261	.066	.252	.421	.118	.200	.235	.447
2	3	.199	.193	.391	.217	.189	.215	.419	.177
3	3	.262	.063	.248	.427	.117	.199	.229	.455
4	3	.217	.155	.350	.278	.168	.211	.363	.258
1	4	.087	.082	.123	.708	.105	.129	.174	.592
2	4	.040	.038	.089	.833	.050	.061	.168	.721
3	4	.078	.074	.116	.732	.095	.117	.173	.615
4	4	.074	.070	.114	.742	.091	.111	.172	.626

Table 2.14

Month: April

Time: Six A.M.

State 6 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.406	.290	.173	.131	.261	.268	.231	.240
2	1	.636	.116	.093	.155	.340	.419	.119	.122
3	1	.419	.280	.169	.132	.266	.276	.224	.234
4	1	.273	.391	.219	.119	.211	.173	.301	.315
1	2	.302	.182	.282	.234	.242	.171	.264	.323
2	2	.152	.396	.211	.241	.218	.101	.317	.364
3	2	.355	.106	.307	.232	.251	.197	.245	.307
4	2	.291	.197	.277	.235	.240	.166	.268	.326
1	3	.047	.132	.519	.302	.080	.167	.417	.336
2	3	.084	.159	.438	.319	.110	.159	.376	.355
3	3	.052	.136	.508	.304	.084	.166	.411	.339
4	3	.170	.223	.246	.361	.185	.140	.274	.401
1	4	.066	.103	.328	.503	.073	.167	.081	.679
2	4	.044	.057	.185	.714	.068	.129	.184	.619
3	4	.062	.094	.301	.543	.072	.160	.101	.667
4	4	.039	.045	.152	.764	.067	.120	.208	.605

State 12 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.215	.434	.240	.111	.189	.130	.332	.349
2	1	.558	.175	.120	.147	.314	.369	.156	.161
3	1	.472	.240	.150	.138	.284	.312	.198	.206
4	1	.372	.316	.185	.127	.248	.243	.249	.260
1	2	.221	.298	.243	.238	.229	.133	.293	.345
2	2	.191	.341	.229	.239	.224	.119	.303	.354
3	2	.260	.242	.262	.236	.235	.151	.279	.335
4	2	.329	.144	.294	.233	.247	.184	.254	.315
1	3	.051	.136	.509	.304	.083	.166	.412	.339
2	3	.000	.098	.622	.280	.042	.176	.468	.314
3	3	.222	.260	.133	.385	.231	.129	.211	.429
4	3	.074	.152	.459	.315	.102	.161	.387	.350
1	4	.054	.078	.250	.618	.070	.146	.138	.646
2	4	.051	.071	.228	.650	.070	.140	.153	.637
3	4	.047	.063	.204	.686	.069	.134	.171	.626
4	4	.041	.049	.162	.748	.068	.122	.201	.609

Table 2.15

Month: April

Time: Noon

State 6 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.345	.270	.252	.133	.435	.152	.147	.266
2	1	.318	.257	.284	.141	.373	.199	.144	.224
3	1	.368	.281	.225	.126	.489	.111	.150	.250
4	1	.344	.269	.254	.133	.432	.155	.146	.267
1	2	.281	.248	.271	.200	.465	.027	.131	.377
2	2	.281	.262	.257	.200	.496	.000	.130	.374
3	2	.278	.141	.380	.201	.220	.235	.139	.406
4	2	.279	.163	.358	.200	.271	.192	.137	.400
1	3	.142	.203	.300	.355	.233	.177	.185	.405
2	3	.252	.120	.169	.459	.253	.000	.160	.587
3	3	.069	.259	.386	.286	.221	.230	.200	.299
4	3	.114	.224	.333	.329	.228	.217	.191	.364
1	4	.034	.093	.165	.708	.174	.085	.097	.644
2	4	.028	.079	.221	.672	.091	.125	.130	.654
3	4	.031	.035	.195	.689	.130	.106	.115	.649
4	4	.035	.096	.155	.714	.188	.078	.092	.642

State 12 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.286	.241	.322	.151	.302	.254	.140	.304
2	1	.337	.266	.261	.136	.416	.167	.146	.271
3	1	.356	.276	.239	.129	.462	.132	.148	.258
4	1	.427	.310	.155	.108	.636	.000	.156	.208
1	2	.230	.247	.273	.200	.462	.029	.131	.378
2	2	.281	.262	.257	.200	.496	.000	.130	.374
3	2	.278	.117	.404	.201	.164	.283	.140	.413
4	2	.280	.211	.309	.200	.382	.098	.133	.387
1	3	.159	.190	.280	.371	.236	.151	.182	.431
2	3	.144	.202	.298	.356	.233	.174	.185	.408
3	3	.071	.257	.384	.288	.222	.277	.200	.301
4	3	.121	.219	.324	.336	.230	.206	.189	.375
1	4	.025	.072	.248	.655	.050	.145	.146	.659
2	4	.031	.086	.194	.689	.132	.105	.114	.649
3	4	.046	.125	.044	.785	.347	.000	.030	.623
4	4	.034	.094	.162	.710	.180	.082	.095	.643

Table 2.16

Month: April

Time: Six P.M.

State 6 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.667	.060	.148	.125	.319	.338	.219	.124
2	1	.585	.127	.202	.086	.320	.173	.266	.241
3	1	.600	.115	.193	.092	.320	.201	.258	.221
4	1	.741	.000	.099	.160	.317	.513	.170	.000
1	2	.443	.302	.164	.091	.340	.142	.155	.363
2	2	.588	.080	.132	.200	.277	.106	.182	.435
3	2	.436	.312	.166	.086	.343	.144	.154	.359
4	2	.573	.103	.135	.189	.283	.110	.180	.427
1	3	.210	.135	.204	.451	.191	.153	.149	.507
2	3	.236	.129	.117	.518	.297	.000	.259	.444
3	3	.204	.136	.228	.432	.163	.195	.118	.524
4	3	.221	.132	.170	.477	.233	.093	.192	.482
1	4	.064	.124	.106	.706	.148	.133	.145	.574
2	4	.120	.000	.022	.858	.066	.096	.056	.782
3	4	.046	.164	.133	.657	.172	.144	.171	.513
4	4	.082	.084	.078	.756	.122	.121	.117	.640

State 12 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.627	.093	.175	.105	.320	.253	.243	.184
2	1	.680	.042	.134	.135	.318	.386	.206	.090
3	1	.614	.104	.183	.099	.320	.228	.250	.202
4	1	.622	.097	.178	.103	.320	.244	.245	.191
1	2	.529	.170	.145	.156	.302	.121	.171	.406
2	2	.592	.074	.131	.203	.275	.105	.183	.437
3	2	.323	.485	.192	.000	.395	.174	.131	.300
4	2	.480	.246	.156	.118	.324	.133	.162	.381
1	3	.223	.132	.160	.485	.245	.076	.204	.475
2	3	.204	.136	.228	.432	.163	.195	.118	.524
3	3	.221	.132	.168	.479	.235	.090	.194	.481
4	3	.216	.134	.185	.465	.215	.119	.173	.493
1	4	.055	.143	.119	.683	.159	.138	.158	.545
2	4	.074	.102	.091	.733	.134	.127	.130	.609
3	4	.042	.172	.139	.647	.177	.146	.177	.500
4	4	.088	.072	.070	.770	.114	.118	.109	.659

Table 2.17

Month: May

Time: Midnight

State 6 hours earlier	resent State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.479	.241	.170	.110	.354	.227	.275	.144
2	1	.453	.224	.188	.135	.282	.211	.298	.209
3	1	.433	.211	.202	.154	.224	.198	.317	.261
4	1	.407	.193	.221	.179	.147	.181	.341	.331
1	2	.007	.486	.087	.420	.000	.001	.498	.501
2	2	.197	.344	.188	.271	.066	.180	.393	.361
3	2	.306	.261	.247	.186	.101	.278	.336	.285
4	2	.209	.334	.195	.262	.069	.192	.387	.352
1	3	.030	.142	.281	.547	.001	.257	.396	.346
2	3	.078	.173	.208	.541	.152	.130	.265	.453
3	3	.086	.179	.195	.540	.176	.110	.245	.469
4	3	.082	.176	.201	.541	.165	.119	.255	.461
1	4	.033	.000	.113	.854	.050	.109	.159	.682
2	4	.139	.197	.136	.528	.135	.236	.316	.313
3	4	.091	.108	.126	.675	.097	.180	.247	.476
4	4	.044	.021	.116	.819	.059	.123	.176	.642

State 12 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.452	.223	.189	.136	.277	.210	.300	.213
2	1	.473	.237	.174	.116	.339	.223	.280	.158
3	1	.456	.226	.186	.132	.290	.213	.296	.201
4	1	.424	.204	.209	.163	.196	.192	.326	.286
1	2	.166	.367	.172	.295	.055	.152	.410	.383
2	2	.130	.294	.153	.323	.043	.119	.429	.409
3	2	.365	.217	.278	.140	.120	.330	.306	.244
4	2	.146	.382	.161	.311	.048	.133	.421	.398
1	3	.130	.207	.129	.534	.307	.000	.132	.561
2	3	.082	.176	.202	.540	.164	.120	.255	.461
3	3	.099	.187	.176	.538	.216	.076	.211	.497
4	3	.053	.157	.246	.544	.076	.194	.331	.299
1	4	.094	.113	.126	.667	.099	.183	.251	.467
2	4	.078	.084	.123	.715	.087	.164	.227	.522
3	4	.076	.081	.122	.721	.085	.162	.225	.528
4	4	.041	.014	.115	.830	.056	.119	.171	.654

Table 2.18

Month: May

Time: Six A.M.

State 6 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.411	.257	.315	.017	.243	.202	.293	.262
2	1	.349	.301	.323	.027	.219	.227	.352	.202
3	1	.362	.292	.321	.025	.224	.222	.340	.214
4	1	.371	.285	.320	.024	.227	.218	.331	.224
1	2	.229	.307	.307	.157	.241	.083	.291	.385
2	2	.175	.142	.371	.312	.000	.338	.363	.299
3	2	.205	.233	.335	.227	.133	.198	.323	.346
4	2	.206	.238	.334	.222	.139	.191	.321	.349
1	3	.102	.132	.432	.334	.137	.032	.308	.523
2	3	.104	.136	.436	.324	.129	.081	.304	.486
3	3	.109	.147	.443	.301	.113	.197	.294	.396
4	3	.114	.156	.451	.279	.097	.309	.285	.309
1	4	.068	.135	.146	.651	.182	.088	.147	.583
2	4	.015	.083	.154	.748	.063	.163	.185	.589
3	4	.045	.113	.149	.693	.130	.121	.164	.585
4	4	.033	.100	.151	.716	.102	.138	.173	.587

State 12 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.521	.177	.302	.000	.289	.157	.186	.368
2	1	.311	.329	.327	.033	.203	.243	.389	.165
3	1	.362	.292	.321	.025	.224	.222	.340	.214
4	1	.335	.311	.324	.030	.213	.233	.366	.188
1	2	.247	.360	.286	.107	.319	.000	.268	.413
2	2	.222	.285	.315	.178	.209	.117	.300	.374
3	2	.194	.202	.348	.256	.087	.246	.337	.330
4	2	.186	.178	.357	.279	.051	.284	.348	.317
1	3	.104	.137	.436	.323	.128	.089	.303	.480
2	3	.101	.129	.430	.340	.141	.000	.311	.548
3	3	.109	.148	.444	.299	.112	.208	.293	.387
4	3	.109	.146	.443	.302	.114	.190	.295	.401
1	4	.064	.132	.146	.658	.173	.094	.150	.583
2	4	.020	.088	.153	.739	.073	.157	.182	.588
3	4	.079	.146	.144	.631	.207	.073	.139	.581
4	4	.024	.092	.152	.732	.082	.151	.179	.588

Table 2.19

Month: May

Time: Noon

State 6 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.500	.199	.202	.099	.519	.114	.113	.254
2	1	.491	.199	.213	.097	.508	.117	.116	.259
3	1	.333	.208	.412	.047	.275	.168	.183	.374
4	1	.537	.197	.155	.111	.566	.104	.099	.231
1	2	.207	.276	.280	.237	.371	.116	.183	.330
2	2	.077	.114	.352	.457	.327	.122	.000	.551
3	2	.269	.353	.246	.132	.389	.114	.255	.242
4	2	.274	.361	.243	.122	.390	.114	.261	.235
1	3	.045	.216	.317	.422	.286	.188	.155	.371
2	3	.034	.221	.318	.427	.280	.197	.150	.373
3	3	.177	.158	.310	.355	.369	.082	.203	.346
4	3	.149	.170	.311	.370	.351	.105	.193	.351
1	4	.027	.084	.211	.678	.179	.103	.175	.543
2	4	.023	.094	.263	.620	.211	.148	.254	.387
3	4	.031	.076	.171	.722	.152	.063	.108	.677
4	4	.031	.077	.176	.716	.157	.069	.117	.657

State 12 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.563	.196	.121	.120	.599	.097	.089	.215
2	1	.186	.215	.599	.000	.000	.229	.262	.509
3	1	.424	.203	.297	.076	.416	.137	.142	.305
4	1	.392	.205	.338	.065	.368	.148	.156	.328
1	2	.170	.229	.301	.300	.360	.118	.135	.387
2	2	.160	.217	.306	.317	.357	.118	.122	.403
3	2	.280	.368	.240	.112	.392	.114	.268	.226
4	2	.255	.337	.254	.154	.385	.115	.240	.260
1	3	.127	.180	.313	.380	.338	.122	.185	.355
2	3	.000	.236	.320	.444	.259	.224	.138	.379
3	3	.090	.196	.315	.399	.315	.152	.171	.362
4	3	.160	.165	.311	.364	.358	.096	.197	.349
1	4	.025	.089	.237	.649	.195	.126	.215	.464
2	4	.037	.063	.112	.788	.110	.000	.000	.890
3	4	.027	.085	.214	.674	.181	.105	.180	.534
4	4	.031	.075	.169	.725	.151	.061	.104	.684

Table 2.20

Month: May

Time: Six P.M.

State 6 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.791	.087	.000	.122	.349	.222	.157	.272
2	1	.792	.087	.000	.121	.349	.222	.157	.272
3	1	.892	.000	.108	.000	.537	.175	.107	.181
4	1	.892	.000	.108	.000	.537	.175	.107	.181
1	2	.462	.201	.184	.153	.411	.301	.000	.288
2	2	.404	.196	.262	.138	.247	.294	.177	.282
3	2	.391	.195	.280	.134	.208	.293	.218	.281
4	2	.317	.189	.379	.115	.000	.285	.442	.273
1	3	.271	.131	.253	.345	.267	.129	.220	.384
2	3	.178	.050	.214	.558	.090	.150	.088	.672
3	3	.297	.155	.264	.284	.318	.123	.258	.301
4	3	.207	.075	.226	.492	.145	.143	.129	.583
1	4	.104	.063	.086	.747	.092	.062	.153	.693
2	4	.119	.183	.138	.560	.187	.133	.095	.588
3	4	.112	.126	.114	.648	.140	.100	.122	.638
4	4	.103	.057	.083	.757	.087	.059	.156	.698

State 12 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.799	.080	.009	.112	.364	.218	.153	.265
2	1	.792	.087	.000	.121	.349	.222	.157	.272
3	1	.792	.087	.000	.121	.349	.222	.157	.272
4	1	.835	.049	.047	.069	.430	.202	.135	.233
1	2	.431	.198	.226	.145	.322	.297	.096	.385
2	2	.425	.198	.234	.143	.306	.297	.113	.284
3	2	.370	.194	.307	.129	.151	.291	.280	.278
4	2	.357	.193	.325	.125	.114	.289	.320	.277
1	3	.277	.137	.256	.330	.279	.128	.229	.364
2	3	.249	.112	.244	.395	.225	.134	.189	.452
3	3	.241	.105	.241	.413	.211	.136	.178	.475
4	3	.207	.075	.226	.492	.145	.144	.129	.582
1	4	.110	.109	.106	.675	.127	.089	.131	.653
2	4	.111	.122	.112	.655	.137	.097	.125	.641
3	4	.105	.073	.091	.731	.100	.069	.147	.684
4	4	.105	.073	.090	.732	.100	.068	.148	.684

Table 2.21

Month: June

Time: Midnight

State 6 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.378	.317	.183	.122	.164	.380	.344	.112
2	1	.381	.296	.178	.145	.120	.376	.332	.172
3	1	.374	.339	.189	.098	.209	.384	.357	.050
4	1	.390	.240	.163	.207	.000	.365	.298	.337
1	2	.431	.247	.093	.229	.216	.329	.159	.296
2	2	.390	.196	.200	.214	.173	.280	.289	.258
3	2	.440	.260	.068	.232	.225	.339	.132	.304
4	2	.314	.097	.402	.187	.080	.175	.570	.175
1	3	.474	.061	.336	.129	.045	.481	.371	.103
2	3	.080	.183	.269	.468	.039	.282	.297	.382
3	3	.026	.200	.260	.514	.038	.254	.287	.421
4	3	.156	.160	.282	.402	.040	.321	.312	.327
1	4	.044	.000	.212	.744	.054	.109	.240	.597
2	4	.039	.042	.196	.723	.056	.121	.274	.549
3	4	.023	.172	.144	.661	.061	.160	.379	.400
4	4	.040	.035	.198	.727	.055	.119	.268	.558

State 12 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.381	.298	.178	.143	.125	.376	.333	.166
2	1	.378	.316	.183	.123	.162	.380	.344	.114
3	1	.381	.397	.178	.144	.123	.376	.333	.168
4	1	.371	.357	.194	.078	.245	.387	.368	.000
1	2	.466	.292	.000	.242	.250	.367	.057	.326
2	2	.388	.193	.206	.213	.170	.278	.296	.256
3	2	.405	.214	.162	.219	.189	.298	.241	.277
4	2	.361	.158	.277	.204	.139	.242	.391	.228
1	3	.263	.127	.300	.310	.042	.376	.332	.250
2	3	.137	.166	.278	.419	.040	.311	.308	.341
3	3	.135	.166	.278	.421	.040	.310	.308	.342
4	3	.092	.180	.271	.457	.039	.288	.300	.373
1	4	.044	.000	.212	.744	.054	.109	.240	.597
2	4	.032	.098	.173	.697	.058	.138	.319	.485
3	4	.034	.082	.180	.704	.057	.133	.306	.504
4	4	.037	.060	.188	.715	.056	.127	.288	.529

Table 2.22

Month: June

Time: Six A.M.

State 6 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.204	.453	.323	.020	.249	.264	.339	.148
2	1	.325	.414	.243	.018	.387	.254	.284	.075
3	1	.000	.518	.459	.023	.000	.282	.437	.281
4	1	.287	.426	.269	.018	.344	.257	.302	.097
1	2	.174	.335	.332	.159	.130	.343	.351	.176
2	2	.173	.342	.326	.159	.131	.337	.346	.186
3	2	.167	.384	.289	.160	.141	.301	.315	.243
4	2	.158	.459	.222	.161	.156	.242	.264	.338
1	3	.071	.253	.391	.285	.185	.150	.295	.370
2	3	.000	.364	.315	.321	.192	.200	.232	.376
3	3	.000	.364	.315	.321	.192	.200	.232	.376
4	3	.173	.094	.500	.233	.176	.079	.385	.360
1	4	.012	.271	.232	.485	.147	.200	.230	.423
2	4	.021	.067	.264	.648	.052	.108	.239	.601
3	4	.015	.205	.242	.538	.116	.170	.233	.481
4	4	.020	.090	.260	.630	.062	.118	.238	.582

State 12 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.199	.454	.327	.020	.244	.264	.341	.151
2	1	.316	.417	.249	.018	.376	.255	.289	.080
3	1	.279	.429	.274	.018	.335	.258	.305	.102
4	1	.104	.485	.390	.021	.130	.273	.386	.211
1	2	.174	.335	.332	.159	.130	.343	.351	.176
2	2	.188	.226	.430	.156	.102	.453	.445	.000
3	2	.167	.389	.234	.160	.142	.297	.311	.250
4	2	.147	.546	.144	.163	.172	.180	.212	.436
1	3	.000	.364	.315	.321	.192	.200	.232	.376
2	3	.000	.364	.315	.321	.192	.200	.232	.376
3	3	.098	.211	.120	.271	.183	.131	.319	.367
4	3	.139	.146	.465	.250	.179	.102	.356	.363
1	4	.009	.358	.218	.415	.189	.240	.226	.345
2	4	.020	.100	.258	.622	.067	.123	.237	.573
3	4	.020	.085	.261	.634	.060	.116	.238	.586
4	4	.019	.120	.255	.606	.077	.132	.236	.555

Table 2.23

Month: June

Time: Noon

State 6 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.432	.199	.280	.089	.422	.330	.155	.093
2	1	.314	.351	.131	.204	.196	.148	.174	.482
3	1	.460	.163	.315	.062	.476	.374	.150	.000
4	1	.460	.163	.315	.062	.476	.374	.150	.000
1	2	.251	.370	.275	.104	.501	.135	.204	.160
2	2	.233	.411	.258	.098	.568	.064	.211	.157
3	2	.276	.314	.298	.112	.408	.233	.195	.164
4	2	.296	.268	.317	.119	.333	.313	.187	.167
1	3	.117	.190	.469	.224	.302	.156	.224	.318
2	3	.124	.201	.501	.174	.331	.150	.206	.313
3	3	.102	.165	.400	.333	.239	.169	.262	.330
4	3	.085	.139	.326	.450	.170	.183	.304	.343
1	4	.048	.031	.096	.825	.013	.000	.131	.856
2	4	.009	.199	.355	.437	.230	.346	.163	.261
3	4	.036	.085	.179	.700	.083	.113	.142	.662
4	4	.037	.082	.174	.707	.079	.107	.141	.673

State 12 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.423	.211	.268	.098	.404	.315	.156	.125
2	1	.384	.261	.220	.135	.330	.255	.163	.252
3	1	.214	.481	.004	.301	.012	.000	.190	.798
4	1	.431	.199	.280	.090	.421	.329	.155	.095
1	2	.237	.401	.262	.100	.551	.082	.209	.158
2	2	.263	.343	.286	.108	.456	.183	.199	.162
3	2	.296	.268	.317	.119	.331	.315	.187	.167
4	2	.270	.328	.292	.110	.431	.209	.197	.163
1	3	.115	.186	.458	.241	.292	.158	.230	.320
2	3	.128	.207	.516	.149	.344	.148	.198	.310
3	3	.089	.145	.342	.424	.186	.180	.294	.340
4	3	.094	.152	.364	.390	.206	.176	.282	.336
1	4	.023	.140	.263	.574	.154	.225	.152	.469
2	4	.032	.100	.201	.667	.102	.143	.144	.611
3	4	.033	.096	.195	.676	.097	.134	.144	.625
4	4	.037	.080	.171	.712	.077	.102	.141	.680

Table 2.24

Month: June

Time: Six P.M.

State 6 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.598	.277	.138	.037	.385	.307	.133	.175
2	1	.650	.205	.091	.054	.361	.365	.127	.147
3	1	.486	.273	.241	.000	.441	.175	.144	.240
4	1	.748	.165	.000	.000	.317	.469	.118	.096
1	2	.359	.266	.172	.163	.231	.163	.262	.344
2	2	.534	.158	.161	.147	.266	.192	.264	.278
3	2	.382	.253	.187	.178	.236	.166	.262	.336
4	2	.139	.404	.230	.227	.188	.126	.260	.426
1	3	.290	.185	.277	.248	.215	.250	.158	.377
2	3	.302	.185	.281	.232	.225	.248	.152	.375
3	3	.235	.186	.255	.324	.166	.262	.186	.386
4	3	.142	.188	.219	.451	.086	.281	.232	.401
1	4	.064	.097	.193	.646	.117	.074	.215	.594
2	4	.143	.131	.398	.528	.063	.213	.348	.376
3	4	.072	.100	.215	.613	.111	.089	.229	.571
4	4	.043	.088	.141	.728	.131	.036	.179	.654

State 12 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.552	.246	.180	.022	.407	.255	.137	.201
2	1	.705	.182	.040	.073	.336	.425	.122	.117
3	1	.487	.272	.240	.001	.440	.177	.144	.239
4	1	.748	.165	.000	.087	.317	.470	.118	.095
1	2	.557	.143	.157	.143	.271	.196	.264	.269
2	2	.544	.152	.159	.145	.268	.193	.264	.275
3	2	.482	.190	.170	.158	.256	.183	.263	.298
4	2	.135	.406	.231	.228	.187	.126	.260	.427
1	3	.335	.184	.295	.186	.255	.241	.135	.369
2	3	.226	.186	.252	.336	.158	.264	.190	.388
3	3	.258	.186	.264	.292	.187	.257	.174	.382
4	3	.153	.188	.223	.436	.095	.279	.226	.400
1	4	.093	.110	.270	.527	.096	.127	.266	.511
2	4	.089	.108	.250	.544	.099	.119	.259	.523
3	4	.067	.099	.203	.631	.114	.080	.222	.584
4	4	.045	.089	.146	.720	.130	.039	.183	.648

Table 2.25

Month: July

Time: Midnight

State 6 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.474	.327	.132	.067	.129	.490	.276	.105
2	1	.324	.266	.229	.181	.078	.328	.438	.156
3	1	.278	.247	.258	.217	.063	.279	.487	.171
4	1	.353	.278	.210	.159	.088	.359	.407	.146
1	2	.436	.308	.256	.000	.117	.466	.346	.071
2	2	.242	.213	.277	.268	.066	.300	.406	.228
3	2	.271	.228	.274	.227	.074	.326	.397	.203
4	2	.000	.095	.302	.603	.000	.085	.483	.432
1	3	.175	.186	.211	.428	.097	.354	.390	.159
2	3	.140	.128	.264	.468	.096	.152	.453	.299
3	3	.147	.140	.253	.460	.096	.191	.441	.272
4	3	.171	.181	.216	.432	.097	.333	.396	.174
1	4	.000	.064	.001	.935	.010	.122	.248	.620
2	4	.022	.104	.195	.679	.043	.194	.228	.535
3	4	.029	.114	.249	.608	.053	.215	.222	.510
4	4	.013	.087	.112	.788	.028	.163	.237	.572

State 12 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.518	.346	.103	.033	.145	.538	.227	.090
2	1	.319	.264	.232	.185	.076	.322	.444	.158
3	1	.351	.277	.211	.161	.088	.357	.408	.147
4	1	.319	.264	.232	.185	.077	.323	.443	.157
1	2	.349	.265	.266	.120	.094	.393	.373	.140
2	2	.209	.197	.281	.313	.057	.272	.416	.255
3	2	.302	.242	.271	.185	.082	.353	.387	.178
4	2	.189	.187	.283	.341	.052	.255	.422	.271
1	3	.212	.251	.153	.384	.098	.582	.319	.001
2	3	.133	.116	.275	.476	.096	.110	.466	.328
3	3	.147	.139	.254	.460	.096	.190	.441	.273
4	3	.186	.205	.194	.415	.097	.421	.369	.113
1	4	.000	.063	.001	.936	.010	.122	.248	.620
2	4	.051	.153	.435	.361	.088	.294	.199	.419
3	4	.020	.099	.174	.707	.039	.186	.230	.545
4	4	.003	.069	.027	.901	.014	.131	.246	.609

Table 2.26

Month: July

Time six A.M.

State 6 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.125	.468	.407	.000	.128	.363	.350	.159
2	1	.169	.500	.331	.000	.241	.315	.294	.150
3	1	.269	.576	.155	.000	.494	.209	.167	.130
4	1	.078	.432	.490	.000	.001	.416	.413	.170
1	2	.102	.403	.371	.124	.248	.287	.293	.172
2	2	.063	.351	.444	.142	.158	.302	.336	.204
3	2	.168	.492	.247	.093	.404	.261	.217	.118
4	2	.218	.559	.154	.069	.526	.240	.158	.076
1	3	.062	.185	.541	.212	.144	.158	.430	.268
2	3	.026	.218	.409	.347	.063	.129	.298	.510
3	3	.051	.195	.501	.253	.120	.150	.392	.338
4	3	.036	.208	.448	.308	.088	.138	.338	.436
1	4	.255	.173	.374	.428	.073	.168	.325	.434
2	4	.026	.175	.378	.421	.073	.168	.328	.431
3	4	.029	.187	.401	.383	.075	.168	.341	.416
4	4	.011	.100	.234	.655	.063	.167	.246	.524

State 12 hours later	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.190	.516	.294	.000	.295	.293	.267	.145
2	1	.149	.435	.366	.000	.189	.337	.320	.154
3	1	.144	.482	.374	.000	.177	.342	.326	.155
4	1	.175	.505	.320	.000	.257	.308	.286	.149
1	2	.146	.462	.289	.103	.351	.269	.243	.137
2	2	.097	.397	.380	.126	.236	.289	.299	.176
3	2	.084	.380	.404	.132	.207	.294	.313	.186
4	2	.169	.495	.244	.092	.408	.260	.215	.117
1	3	.000	.242	.316	.442	.000	.105	.195	.700
2	3	.051	.195	.502	.252	.121	.150	.392	.337
3	3	.059	.188	.529	.224	.137	.156	.419	.288
4	3	.049	.197	.494	.260	.116	.148	.385	.351
1	4	.037	.231	.485	.247	.082	.169	.389	.360
2	4	.026	.175	.378	.421	.073	.168	.328	.431
3	4	.016	.124	.280	.580	.066	.167	.272	.495
4	4	.014	.115	.264	.607	.065	.167	.263	.505

Table 2.27

Month: July

Time: Noon

State 6 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.421	.229	.331	.019	.478	.302	.136	.084
2	1	.703	.199	.060	.038	.436	.231	.256	.077
3	1	.765	.192	.000	.043	.428	.217	.279	.076
4	1	.174	.255	.565	.001	.522	.375	.013	.090
1	2	.314	.320	.221	.145	.401	.230	.145	.174
2	2	.348	.324	.188	.140	.428	.238	.181	.153
3	2	.154	.304	.372	.170	.271	.191	.259	.279
4	2	.110	.299	.414	.177	.234	.180	.278	.308
1	3	.103	.331	.277	.189	.356	.246	.167	.231
2	3	.101	.313	.382	.204	.341	.237	.180	.242
3	3	.091	.119	.430	.360	.192	.140	.318	.350
4	3	.096	.213	.406	.285	.264	.187	.251	.298
1	4	---	---	---	---	---	---	---	---
2	4	.035	.158	.302	.505	.464	.207	.062	.267
3	4	.018	.103	.233	.646	.231	.068	.199	.502
4	4	.018	.102	.231	.649	.226	.065	.202	.507

State 12 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.660	.203	.101	.036	.442	.241	.239	.078
2	1	.157	.257	.586	.000	.526	.383	.000	.091
3	1	.648	.205	.113	.034	.444	.244	.234	.078
4	1	.568	.213	.190	.029	.455	.263	.201	.081
1	2	.220	.311	.309	.160	.325	.208	.232	.235
2	2	.238	.313	.292	.157	.340	.212	.225	.223
3	2	.410	.330	.129	.131	.477	.252	.157	.114
4	2	.220	.311	.309	.160	.325	.208	.232	.235
1	3	.098	.241	.399	.262	.286	.201	.231	.282
2	3	.094	.181	.414	.311	.239	.171	.274	.316
3	3	.094	.172	.416	.318	.233	.167	.280	.320
4	3	.102	.311	.382	.205	.340	.236	.181	.243
1	4	.019	.106	.236	.639	.244	.075	.192	.489
2	4	.026	.130	.266	.578	.348	.137	.131	.384
3	4	.023	.120	.254	.603	.305	.112	.156	.427
4	4	.016	.096	.224	.664	.199	.049	.218	.534

Table 2.28

Month: July

Time: Six P.M.

State 6 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.451	.217	.266	.066	.366	.356	.071	.207
2	1	.625	.197	.160	.018	.443	.161	.281	.115
3	1	.471	.214	.254	.061	.374	.334	.095	.197
4	1	.661	.192	.139	.008	.459	.121	.324	.096
1	2	.435	.467	.098	.000	.254	.302	.208	.236
2	2	.443	.314	.131	.112	.238	.216	.213	.333
3	2	.449	.212	.153	.186	.227	.163	.216	.394
4	2	.453	.148	.167	.232	.221	.131	.217	.431
1	3	.331	.278	.185	.206	.264	.164	.221	.351
2	3	.212	.105	.369	.314	.121	.196	.310	.373
3	3	.299	.232	.234	.235	.225	.173	.245	.357
4	3	.250	.161	.310	.279	.166	.186	.282	.366
1	4	.000	.447	.549	.004	.117	.181	.701	.001
2	4	.098	.157	.281	.464	.092	.146	.290	.472
3	4	.111	.120	.246	.523	.089	.141	.232	.538
4	4	.137	.041	.173	.649	.081	.130	.109	.680

State 12 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.613	.198	.168	.021	.437	.175	.267	.121
2	1	.564	.204	.197	.035	.416	.229	.208	.147
3	1	.443	.218	.271	.068	.362	.366	.060	.212
4	1	.550	.205	.206	.039	.410	.245	.191	.154
1	2	.441	.350	.123	.086	.241	.236	.212	.311
2	2	.447	.247	.146	.160	.231	.181	.215	.373
3	2	.449	.212	.153	.186	.227	.163	.216	.394
4	2	.450	.198	.156	.196	.226	.156	.216	.402
1	3	.383	.353	.105	.159	.331	.149	.180	.340
2	3	.265	.182	.287	.266	.183	.182	.272	.363
3	3	.197	.083	.392	.328	.105	.200	.320	.375
4	3	.261	.177	.293	.269	.179	.183	.274	.364
1	4	.108	.127	.253	.512	.089	.142	.243	.526
2	4	.109	.123	.250	.518	.089	.142	.238	.531
3	4	.110	.122	.249	.519	.089	.141	.237	.533
4	4	.135	.048	.181	.636	.082	.131	.121	.666

Table 2.29

Month: August

Time: Midnight

State 6 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.500	.300	.113	.087	.252	.384	.308	.056
2	1	.439	.306	.131	.124	.215	.355	.257	.173
3	1	.477	.302	.120	.101	.238	.373	.289	.100
4	1	.280	.322	.176	.222	.111	.277	.121	.491
1	2	.348	.262	.243	.147	.167	.275	.501	.057
2	2	.264	.186	.279	.271	.109	.324	.385	.182
3	2	.176	.106	.317	.401	.044	.379	.256	.321
4	2	.338	.254	.247	.161	.161	.280	.488	.071
1	3	.260	.102	.256	.382	.105	.229	.309	.357
2	3	.225	.096	.309	.370	.086	.225	.348	.341
3	3	.293	.109	.205	.393	.123	.232	.272	.373
4	3	.219	.095	.318	.368	.083	.224	.354	.339
1	4	.032	.000	.173	.795	.012	.289	.271	.428
2	4	.060	.100	.138	.702	.055	.116	.353	.476
3	4	.059	.096	.139	.706	.054	.122	.350	.474
4	4	.043	.039	.160	.758	.029	.221	.304	.446

State 12 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.491	.301	.116	.092	.248	.380	.301	.071
2	1	.420	.308	.136	.136	.203	.346	.242	.209
3	1	.459	.304	.125	.112	.227	.365	.274	.134
4	1	.459	.304	.125	.112	.227	.364	.274	.135
1	2	.258	.181	.281	.280	.105	.328	.376	.191
2	2	.285	.205	.270	.240	.124	.311	.415	.150
3	2	.254	.177	.283	.286	.102	.330	.370	.198
4	2	.264	.186	.279	.271	.109	.324	.385	.182
1	3	.379	.125	.076	.420	.168	.241	.179	.412
2	3	.063	.066	.553	.318	.000	.207	.526	.267
3	3	.254	.101	.265	.380	.102	.228	.315	.355
4	3	.316	.113	.171	.400	.134	.235	.248	.283
1	4	.048	.057	.153	.742	.037	.190	.318	.455
2	4	.054	.079	.145	.722	.046	.152	.336	.466
3	4	.056	.086	.153	.715	.050	.139	.342	.469
4	4	.042	.035	.161	.762	.027	.227	.301	.445

Table 2.30

Month: August

Time: Six A.M.

State 6 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.319	.430	.202	.049	.306	.318	.278	.098
2	1	.341	.448	.178	.033	.309	.309	.286	.096
3	1	.173	.309	.364	.154	.282	.383	.229	.106
4	1	.354	.458	.164	.024	.311	.303	.290	.096
1	2	.175	.397	.359	.069	.223	.250	.234	.193
2	2	.000	.441	.433	.126	.111	.278	.369	.242
3	2	.391	.342	.267	.000	.415	.473	.001	.111
4	2	.000	.441	.433	.126	.111	.278	.369	.242
1	3	.104	.247	.216	.433	.154	.183	.388	.275
2	3	.075	.266	.495	.164	.157	.232	.342	.269
3	3	.085	.260	.402	.253	.156	.215	.357	.271
4	3	.074	.266	.505	.155	.157	.234	.340	.269
1	4	.015	.134	.306	.545	.124	.167	.225	.484
2	4	.066	.189	.406	.339	.140	.186	.327	.347
3	4	.000	.118	.277	.605	.119	.161	.196	.524
4	4	.008	.126	.292	.574	.122	.164	.211	.503

State 12 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.317	.428	.204	.051	.305	.319	.278	.098
2	1	.341	.447	.178	.034	.309	.309	.285	.097
3	1	.205	.336	.328	.131	.287	.369	.240	.104
4	1	.387	.486	.127	.000	.317	.288	.301	.094
1	2	.240	.381	.331	.048	.274	.383	.172	.171
2	2	.131	.408	.377	.084	.192	.330	.271	.207
3	2	.120	.411	.382	.087	.184	.326	.280	.210
4	2	.000	.441	.433	.126	.111	.278	.369	.242
1	3	.068	.270	.563	.099	.158	.243	.331	.268
2	3	.089	.257	.361	.293	.156	.209	.363	.272
3	3	.088	.257	.370	.285	.156	.210	.362	.272
4	3	.081	.262	.443	.214	.157	.223	.350	.270
1	4	.079	.204	.432	.285	.144	.191	.354	.311
2	4	.000	.118	.277	.605	.119	.161	.196	.524
3	4	.000	.118	.277	.605	.120	.161	.196	.523
4	4	.016	.135	.308	.541	.124	.167	.227	.482

Table 2.31

Month: August

Time: Noon

State 6 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.390	.418	.154	.038	.580	.104	.107	.209
2	1	.646	.353	.001	.000	.329	.130	.443	.098
3	1	.452	.403	.116	.029	.516	.111	.192	.181
4	1	.312	.438	.200	.050	.660	.096	.000	.244
1	2	.271	.325	.280	.114	.456	.163	.136	.245
2	2	.248	.350	.288	.114	.391	.261	.107	.241
3	2	.203	.400	.302	.095	.265	.452	.049	.234
4	2	.285	.309	.276	.130	.497	.100	.155	.248
1	3	.149	.226	.367	.258	.347	.223	.089	.341
2	3	.152	.231	.328	.289	.261	.193	.221	.325
3	3	.153	.234	.308	.305	.218	.177	.288	.317
4	3	.149	.226	.366	.259	.345	.223	.091	.341
1	4	.074	.137	.591	.198	.510	.104	.183	.203
2	4	.061	.109	.274	.556	.243	.087	.155	.515
3	4	.067	.120	.402	.41	.347	.094	.166	.393
4	4	.056	.099	.155	.690	.151	.082	.145	.622

State 12 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.463	.400	.110	.027	.506	.112	.206	.176
2	1	.312	.438	.200	.050	.660	.096	.000	.244
3	1	.521	.385	.075	.019	.448	.118	.243	.151
4	1	.312	.438	.200	.050	.660	.096	.000	.244
1	2	.255	.342	.285	.118	.412	.229	.116	.243
2	2	.282	.313	.277	.128	.487	.116	.150	.247
3	2	.239	.360	.291	.110	.366	.299	.095	.240
4	2	.352	.346	.286	.116	.402	.244	.112	.242
1	3	.148	.225	.374	.253	.362	.228	.066	.344
2	3	.153	.233	.312	.302	.227	.180	.274	.319
3	3	.155	.235	.293	.317	.183	.165	.341	.311
4	3	.150	.227	.355	.268	.320	.214	.130	.336
1	4	.066	.119	.386	.429	.334	.093	.165	.408
2	4	.064	.114	.336	.486	.292	.091	.160	.457
3	4	.057	.101	.180	.662	.170	.083	.147	.600
4	4	.056	.100	.165	.679	.159	.082	.146	.613

Table 2.32

Month: August

Time: Six P.M.

State 6 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.646	.182	.145	.027	.397	.276	.149	.178
2	1	.648	.183	.128	.041	.385	.358	.162	.195
3	1	.643	.180	.164	.013	.518	.187	.134	.161
4	1	.649	.183	.124	.044	.265	.373	.164	.198
1	2	.584	.000	.212	.204	.513	.108	.057	.322
2	2	.402	.357	.077	.164	.175	.320	.289	.216
3	2	.451	.261	.113	.175	.274	.258	.221	.247
4	2	.543	.080	.182	.195	.444	.151	.104	.301
1	3	.165	.181	.125	.529	.256	.000	.168	.576
2	3	.287	.170	.228	.315	.266	.156	.180	.398
3	3	.253	.173	.199	.375	.263	.113	.177	.447
4	3	.301	.169	.239	.291	.267	.173	.181	.379
1	4	.000	.103	.196	.701	.249	.000	.227	.524
2	4	.157	.072	.037	.734	.000	.139	.112	.749
3	4	.069	.089	.126	.716	.136	.063	.175	.626
4	4	.066	.090	.129	.715	.140	.061	.177	.622

State 12 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.646	.182	.144	.028	.393	.279	.149	.179
2	1	.649	.183	.123	.045	.255	.380	.166	.199
3	1	.641	.179	.180	.000	.625	.108	.122	.145
4	1	.648	.183	.128	.041	.286	.357	.162	.195
1	2	.465	.233	.124	.178	.302	.241	.202	.255
2	2	.462	.239	.121	.178	.296	.244	.206	.254
3	2	.373	.414	.055	.158	.113	.359	.332	.196
4	2	.514	.137	.160	.189	.393	.184	.139	.284
1	3	.305	.168	.242	.385	.267	.177	.182	.374
2	3	.288	.170	.228	.314	.266	.157	.180	.397
3	3	.334	.166	.267	.233	.269	.214	.185	.332
4	3	.198	.178	.152	.472	.258	.042	.172	.528
1	4	.129	.077	.065	.729	.041	.116	.131	.712
2	4	.055	.092	.140	.713	.159	.051	.185	.605
3	4	.049	.093	.146	.712	.168	.046	.189	.597
4	4	.079	.087	.116	.718	.121	.072	.167	.640

Table 2.33

Month: September

Time: Midnight

State 6 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.581	.205	.121	.093	.443	.311	.170	.076
2	1	.574	.205	.142	.079	.302	.289	.243	.166
3	1	.584	.205	.112	.099	.498	.319	.142	.041
4	1	.574	.205	.141	.080	.309	.291	.239	.161
1	2	.304	.287	.123	.286	.253	.360	.065	.322
2	2	.271	.168	.268	.293	.142	.236	.392	.230
3	2	.263	.162	.276	.294	.136	.229	.411	.224
4	2	.287	.227	.196	.290	.197	.298	.229	.276
1	3	.113	.153	.416	.318	.170	.069	.302	.459
2	3	.209	.389	.072	.330	.122	.267	.211	.310
3	3	.138	.214	.327	.321	.157	.120	.279	.444
4	3	.127	.188	.365	.320	.162	.099	.289	.450
1	4	.000	.032	.089	.879	.023	.123	.310	.544
2	4	.142	.071	.223	.564	.210	.149	.270	.371
3	4	.086	.056	.170	.688	.137	.139	.285	.439
4	4	.042	.044	.129	.785	.079	.131	.298	.492

State 12 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.581	.205	.121	.093	.444	.311	.170	.075
2	1	.581	.205	.121	.093	.437	.310	.173	.080
3	1	.577	.205	.131	.087	.377	.301	.204	.118
4	1	.572	.205	.146	.077	.276	.286	.256	.182
1	2	.293	.247	.172	.288	.215	.319	.175	.291
2	2	.270	.168	.269	.293	.141	.235	.395	.229
3	2	.263	.141	.301	.295	.117	.208	.467	.208
4	2	.291	.242	.178	.289	.211	.314	.188	.287
1	3	.137	.211	.331	.321	.158	.119	.279	.444
2	3	.195	.354	.123	.328	.129	.239	.221	.408
3	3	.107	.138	.438	.317	.173	.055	.309	.463
4	3	.161	.270	.245	.324	.146	.168	.257	.429
1	4	.196	.086	.274	.444	.280	.159	.255	.306
2	4	.069	.051	.154	.726	.114	.136	.290	.460
3	4	.000	.032	.089	.879	.023	.123	.310	.544
4	4	.064	.049	.149	.738	.107	.135	.292	.466

Table 2.34

Month: September

Time: Six A.M.

State 6 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.448	.365	.155	.032	.491	.241	.168	.100
2	1	.367	.357	.194	.082	.434	.278	.191	.097
3	1	.110	.331	.316	.243	.242	.396	.262	.090
4	1	.367	.357	.194	.082	.433	.279	.191	.097
1	2	.375	.226	.315	.084	.313	.243	.276	.168
2	2	.368	.238	.354	.040	.322	.317	.283	.078
3	2	.389	.198	.229	.184	.293	.068	.257	.382
4	2	.363	.249	.388	.000	.329	.381	.290	.000
1	3	.177	.321	.249	.253	.233	.261	.280	.226
2	3	.197	.141	.322	.340	.186	.137	.291	.386
3	3	.203	.077	.349	.371	.170	.095	.295	.440
4	3	.169	.390	.221	.220	.251	.310	.275	.164
1	4	.106	.153	.322	.419	.252	.125	.077	.546
2	4	.041	.078	.279	.602	.101	.123	.207	.569
3	4	.000	.030	.251	.719	.000	.122	.293	.585
4	4	.052	.091	.286	.571	.128	.123	.184	.565

State 12 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.499	.370	.131	.000	.527	.218	.154	.101
2	1	.345	.355	.204	.096	.418	.288	.197	.097
3	1	.451	.365	.154	.030	.493	.240	.167	.100
4	1	.268	.347	.241	.144	.363	.324	.219	.094
1	2	.375	.226	.316	.083	.313	.245	.276	.166
2	2	.379	.217	.287	.117	.307	.187	.270	.236
3	2	.373	.228	.324	.075	.315	.259	.277	.149
4	2	.369	.236	.348	.047	.320	.305	.282	.093
1	3	.197	.132	.326	.345	.183	.131	.292	.394
2	3	.194	.164	.313	.329	.191	.153	.290	.366
3	3	.182	.276	.267	.275	.221	.229	.283	.267
4	3	.182	.273	.269	.276	.220	.227	.283	.270
1	4	.061	.101	.292	.546	.149	.123	.166	.562
2	4	.040	.077	.278	.605	.099	.123	.208	.570
3	4	.056	.094	.288	.562	.135	.123	.178	.564
4	4	.044	.080	.280	.596	.107	.123	.202	.568

Table 2.35

Month: September

Time: Noon

State 6 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.695	.213	.081	.011	.650	.133	.111	.106
2	1	.516	.204	.276	.004	.500	.279	.083	.138
3	1	.514	.204	.278	.004	.499	.280	.083	.138
4	1	.769	.217	.000	.014	.711	.074	.122	.093
1	2	.391	.312	.226	.071	.562	.220	.126	.092
2	2	.327	.387	.100	.186	.470	.153	.128	.249
3	2	.322	.393	.091	.194	.463	.148	.128	.261
4	2	.306	.412	.058	.224	.441	.132	.128	.299
1	3	.141	.215	.346	.298	.296	.172	.265	.267
2	3	.183	.217	.337	.263	.355	.324	.081	.240
3	3	.120	.215	.350	.315	.268	.097	.354	.281
4	3	.124	.215	.349	.312	.271	.108	.342	.279
1	4	.130	.302	.406	.162	.283	.298	.070	.349
2	4	.047	.084	.234	.635	.184	.109	.139	.568
3	4	.019	.009	.176	.796	.146	.036	.166	.652
4	4	.029	.034	.196	.741	.159	.061	.157	.623

State 12 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.668	.212	.110	.010	.628	.154	.107	.111
2	1	.620	.210	.162	.008	.589	.193	.099	.119
3	1	.427	.200	.373	.000	.424	.353	.069	.154
4	1	.632	.210	.150	.008	.598	.184	.101	.117
1	2	.377	.327	.200	.096	.542	.206	.127	.125
2	2	.362	.346	.169	.123	.520	.189	.127	.164
3	2	.277	.447	.000	.276	.400	.102	.129	.369
4	2	.324	.391	.093	.192	.465	.149	.128	.258
1	3	.132	.215	.348	.305	.284	.139	.304	.273
2	3	.109	.215	.352	.324	.252	.057	.403	.288
3	3	.191	.217	.335	.357	.365	.351	.049	.235
4	3	.133	.215	.347	.305	.285	.143	.299	.273
1	4	.056	.107	.253	.584	.196	.131	.131	.542
2	4	.067	.136	.275	.522	.209	.157	.122	.512
3	4	.016	.000	.169	.815	.142	.027	.169	.662
4	4	.029	.035	.196	.740	.160	.062	.156	.622

Table 2.38

Month: October

Time: Six A.M.

State 6 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.563	.293	.104	.040	.640	.185	.144	.031
2	1	.542	.309	.104	.045	.617	.193	.148	.042
3	1	.549	.304	.104	.043	.625	.190	.147	.038
4	1	.392	.421	.109	.078	.455	.247	.176	.122
1	2	.349	.318	.208	.125	.472	.181	.186	.161
2	2	.553	.287	.160	.000	.603	.280	.055	.062
3	2	.399	.310	.197	.094	.505	.206	.153	.136
4	2	.210	.338	.242	.210	.378	.109	.281	.232
1	3	.148	.153	.399	.300	.334	.113	.193	.360
2	3	.146	.214	.278	.362	.308	.126	.155	.411
3	3	.145	.222	.264	.269	.305	.128	.151	.417
4	3	.148	.142	.421	.289	.338	.110	.200	.352
1	4	.072	.030	.297	.601	.180	.117	.222	.481
2	4	.084	.034	.368	.514	.224	.100	.289	.387
3	4	.072	.031	.303	.594	.184	.115	.228	.473
4	4	.049	.023	.164	.764	.101	.147	.101	.651

State 12 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.620	.251	.102	.027	.702	.164	.134	.000
2	1	.465	.366	.107	.062	.533	.220	.163	.084
3	1	.334	.464	.111	.091	.392	.268	.187	.153
4	1	.620	.251	.102	.027	.702	.164	.134	.000
1	2	.317	.323	.216	.144	.451	.165	.207	.177
2	2	.553	.288	.159	.000	.603	.280	.055	.062
3	2	.354	.317	.207	.122	.476	.183	.183	.158
4	2	.355	.317	.207	.121	.476	.184	.182	.158
1	3	.144	.259	.191	.406	.290	.136	.128	.446
2	3	.144	.269	.171	.416	.286	.138	.122	.454
3	3	.150	.106	.492	.252	.253	.102	.223	.322
4	3	.151	.061	.591	.207	.372	.092	.251	.285
1	4	.085	.034	.374	.507	.227	.099	.295	.379
2	4	.075	.031	.315	.579	.191	.113	.239	.457
3	4	.060	.027	.228	.685	.139	.132	.159	.570
4	4	.046	.023	.149	.782	.092	.150	.088	.670

Table 2.39

Month: October

Time: Noon

State 6 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.729	.187	.064	.020	.663	.137	.123	.077
2	1	.747	.191	.062	.000	.681	.135	.137	.047
3	1	.662	.173	.073	.092	.595	.147	.068	.190
4	1	.582	.157	.084	.177	.510	.158	.001	.331
1	2	.493	.265	.194	.048	.675	.062	.115	.148
2	2	.501	.207	.168	.124	.565	.111	.140	.184
3	2	.516	.103	.120	.261	.381	.193	.182	.244
4	2	.497	.234	.180	.089	.615	.088	.129	.168
1	3	.506	.079	.415	.000	.437	.204	.246	.113
2	3	.259	.207	.255	.279	.378	.132	.149	.341
3	3	.296	.188	.279	.237	.388	.143	.164	.305
4	3	.187	.245	.208	.360	.360	.110	.118	.412
1	4	.266	.146	.440	.148	.313	.211	.294	.182
2	4	.173	.109	.292	.426	.245	.162	.210	.383
3	4	.083	.074	.151	.692	.180	.116	.132	.572
4	4	.071	.069	.133	.727	.172	.110	.121	.597

State 12 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.729	.187	.064	.020	.663	.138	.123	.076
2	1	.680	.177	.071	.072	.614	.144	.083	.159
3	1	.702	.181	.068	.049	.635	.141	.101	.123
4	1	.663	.173	.073	.091	.595	.147	.069	.189
1	2	.499	.218	.172	.111	.584	.102	.136	.178
2	2	.513	.123	.129	.235	.414	.178	.175	.233
3	2	.502	.200	.164	.134	.551	.117	.144	.188
4	2	.494	.253	.188	.065	.650	.073	.121	.156
1	3	.315	.178	.291	.216	.392	.149	.172	.287
2	3	.343	.164	.309	.184	.399	.158	.183	.260
3	3	.296	.188	.279	.237	.388	.143	.164	.305
4	3	.150	.264	.184	.402	.350	.098	.103	.449
1	4	.143	.098	.246	.513	.223	.147	.185	.445
2	4	.102	.082	.181	.635	.194	.126	.148	.532
3	4	.112	.086	.197	.605	.201	.131	.157	.511
4	4	.058	.064	.112	.766	.162	.104	.110	.624

Table 2.40

Month: October

Time: Six P.M.

State 6 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.821	.091	.045	.043	.454	.235	.171	.140
2	1	.790	.090	.066	.054	.437	.244	.181	.138
3	1	.615	.086	.184	.115	.336	.298	.237	.129
4	1	.617	.086	.183	.114	.338	.297	.236	.129
1	2	.382	.201	.267	.150	.251	.119	.329	.301
2	2	.520	.161	.319	.000	.336	.039	.378	.247
3	2	.355	.209	.256	.180	.235	.134	.319	.312
4	2	.310	.222	.239	.229	.208	.159	.304	.329
1	3	.339	.280	.099	.282	.323	.065	.215	.397
2	3	.254	.090	.259	.397	.112	.142	.305	.441
3	3	.273	.131	.224	.372	.162	.124	.283	.431
4	3	.304	.203	.164	.329	.243	.094	.249	.414
1	4	.089	.251	.000	.660	.042	.177	.217	.564
2	4	.100	.079	.113	.708	.145	.068	.136	.651
3	4	.095	.169	.053	.683	.092	.124	.178	.606
4	4	.099	.096	.102	.703	.135	.079	.144	.642

State 12 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.856	.091	.022	.031	.475	.224	.159	.142
2	1	.682	.088	.139	.091	.375	.278	.215	.132
3	1	.686	.088	.136	.090	.377	.276	.214	.133
4	1	.651	.087	.160	.102	.357	.287	.225	.131
1	2	.445	.183	.290	.082	.289	.083	.351	.277
2	2	.472	.175	.301	.052	.306	.067	.361	.266
3	2	.256	.238	.219	.287	.176	.189	.285	.350
4	2	.364	.207	.260	.169	.241	.128	.323	.308
1	3	.247	.073	.273	.407	.090	.150	.314	.446
2	3	.355	.317	.068	.260	.360	.052	.199	.389
3	3	.310	.214	.154	.322	.255	.090	.244	.411
4	3	.281	.151	.208	.360	.184	.116	.274	.426
1	4	.100	.073	.117	.710	.148	.065	.134	.653
2	4	.089	.251	.000	.660	.041	.177	.218	.564
3	4	.103	.032	.144	.721	.171	.041	.116	.672
4	4	.098	.120	.086	.696	.121	.093	.155	.631

Table 2.41

Month: November

Time: Midnight

State 6 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.369	.297	.225	.109	.247	.227	.240	.286
2	1	.503	.208	.218	.071	.221	.237	.295	.247
3	1	.363	.301	.226	.110	.248	.227	.238	.287
4	1	.431	.256	.222	.091	.235	.232	.265	.268
1	2	.188	.261	.303	.248	.203	.303	.247	.247
2	2	.190	.261	.299	.250	.200	.300	.251	.249
3	2	.239	.255	.221	.285	.149	.225	.341	.285
4	2	.218	.257	.255	.270	.170	.255	.305	.270
1	3	.275	.156	.343	.226	.247	.369	.232	.152
2	3	.251	.139	.301	.309	.200	.276	.252	.272
3	3	.202	.103	.213	.482	.102	.085	.294	.517
4	3	.180	.087	.174	.559	.059	.000	.312	.629
1	4	.138	.179	.192	.491	.000	.386	.162	.452
2	4	.000	.048	.096	.856	.133	.000	.144	.723
3	4	.085	.129	.155	.631	.053	.234	.155	.558
4	4	.033	.079	.118	.770	.103	.088	.148	.661

State 12 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.387	.285	.224	.104	.244	.228	.248	.280
2	1	.370	.296	.225	.109	.247	.227	.241	.285
3	1	.212	.402	.233	.153	.277	.216	.176	.331
4	1	.563	.168	.215	.054	.210	.241	.319	.230
1	2	.086	.274	.467	.173	.344	.509	.000	.147
2	2	.210	.259	.267	.264	.178	.267	.291	.264
3	2	.185	.262	.308	.245	.207	.309	.240	.244
4	2	.278	.250	.158	.314	.113	.172	.404	.311
1	3	.260	.145	.316	.279	.217	.309	.245	.229
2	3	.230	.124	.263	.383	.158	.194	.270	.378
3	3	.239	.130	.278	.353	.175	.227	.263	.335
4	3	.202	.103	.213	.482	.102	.085	.294	.519
1	4	.082	.125	.153	.640	.056	.224	.155	.565
2	4	.049	.094	.130	.727	.088	.152	.150	.630
3	4	.067	.112	.142	.679	.070	.183	.153	.594
4	4	.033	.079	.119	.769	.102	.090	.148	.660

Table 2.42

Month: November

Time: Six A.M.

State 6 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.348	.294	.287	.071	.412	.166	.200	.222
2	1	.420	.245	.206	.129	.425	.231	.222	.122
3	1	.354	.290	.281	.075	.413	.171	.201	.215
4	1	.328	.307	.311	.054	.409	.149	.193	.249
1	2	.236	.166	.282	.316	.347	.139	.168	.346
2	2	.163	.460	.244	.133	.529	.125	.206	.140
3	2	.233	.181	.280	.306	.357	.138	.170	.335
4	2	.188	.359	.257	.196	.467	.130	.193	.210
1	3	.133	.234	.235	.398	.296	.122	.184	.398
2	3	.196	.177	.407	.220	.205	.160	.250	.385
3	3	.134	.233	.238	.395	.294	.123	.185	.398
4	3	.101	.263	.150	.486	.341	.104	.151	.404
1	4	.061	.185	.184	.570	.278	.187	.162	.373
2	4	.060	.178	.181	.581	.271	.183	.159	.387
3	4	.055	.077	.151	.717	.178	.137	.123	.562
4	4	.053	.056	.144	.747	.158	.127	.115	.600

State 12 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.328	.307	.310	.055	.409	.149	.193	.249
2	1	.436	.234	.187	.143	.428	.246	.227	.099
3	1	.262	.352	.386	.000	.397	.092	.173	.338
4	1	.387	.267	.243	.103	.419	.201	.212	.168
1	2	.222	.224	.274	.280	.383	.137	.175	.305
2	2	.214	.258	.270	.258	.404	.135	.180	.281
3	2	.223	.218	.275	.284	.379	.137	.175	.309
4	2	.190	.352	.258	.200	.463	.130	.192	.215
1	3	.148	.221	.277	.354	.273	.132	.200	.395
2	3	.161	.209	.311	.319	.256	.139	.213	.392
3	3	.070	.291	.066	.573	.385	.085	.119	.411
4	3	.140	.228	.254	.378	.286	.127	.191	.396
1	4	.061	.181	.182	.576	.274	.185	.160	.381
2	4	.058	.132	.167	.643	.228	.162	.143	.467
3	4	.057	.115	.162	.666	.213	.154	.137	.496
4	4	.053	.042	.140	.765	.145	.121	.111	.623

Table 2.43

Month: November

Time: Noon

State 6 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.647	.172	.105	.076	.586	.120	.102	.192
2	1	.703	.175	.122	.000	.535	.061	.231	.173
3	1	.673	.173	.113	.041	.562	.092	.163	.183
4	1	.642	.171	.104	.083	.591	.125	.090	.194
1	2	.276	.261	.159	.304	.434	.099	.095	.372
2	2	.419	.170	.186	.225	.435	.166	.087	.312
3	2	.612	.048	.221	.119	.437	.252	.075	.236
4	2	.371	.201	.177	.251	.434	.144	.090	.332
1	3	.228	.147	.380	.245	.303	.109	.261	.327
2	3	.305	.179	.235	.281	.357	.121	.137	.385
3	3	.285	.171	.273	.271	.343	.118	.169	.370
4	3	.351	.198	.148	.303	.389	.128	.064	.419
1	4	.200	.071	.180	.549	.264	.084	.189	.463
2	4	.205	.069	.183	.543	.266	.084	.192	.458
3	4	.048	.116	.097	.739	.225	.077	.079	.619
4	4	.087	.104	.118	.691	.235	.079	.107	.579

State 12 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.684	.174	.116	.026	.552	.080	.189	.179
2	1	.703	.175	.122	.000	.535	.061	.231	.173
3	1	.605	.170	.093	.132	.627	.166	.000	.207
4	1	.657	.172	.108	.063	.577	.109	.125	.188
1	2	.349	.215	.173	.263	.434	.133	.091	.342
2	2	.362	.206	.175	.257	.434	.140	.090	.336
3	2	.366	.204	.176	.254	.434	.141	.090	.335
4	2	.557	.082	.212	.149	.436	.228	.079	.257
1	3	.217	.142	.402	.239	.294	.107	.280	.319
2	3	.321	.185	.206	.288	.367	.124	.113	.396
3	3	.332	.190	.184	.294	.376	.125	.094	.405
4	3	.358	.201	.135	.306	.393	.130	.053	.424
1	4	.118	.095	.135	.652	.244	.080	.130	.546
2	4	.188	.074	.174	.564	.261	.083	.181	.475
3	4	.000	.130	.070	.800	.212	.075	.042	.671
4	4	.100	.100	.125	.675	.239	.079	.117	.565

Table 2.44

Month: November

Time: Six P.M.

State 6 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.682	.093	.135	.090	.333	.255	.236	.176
2	1	.644	.245	.047	.064	.343	.273	.201	.183
3	1	.679	.107	.127	.087	.333	.257	.233	.177
4	1	.685	.082	.141	.092	.332	.253	.239	.176
1	2	.380	.197	.258	.165	.332	.168	.205	.295
2	2	.498	.112	.072	.318	.337	.089	.074	.500
3	2	.366	.207	.280	.147	.332	.177	.221	.270
4	2	.382	.195	.255	.168	.333	.166	.203	.298
1	3	.254	.110	.231	.405	.180	.216	.211	.393
2	3	.278	.114	.236	.372	.070	.105	.468	.357
3	3	.257	.110	.232	.401	.168	.204	.239	.389
4	3	.242	.107	.229	.422	.238	.275	.075	.412
1	4	.190	.122	.095	.593	.057	.063	.452	.428
2	4	.146	.061	.060	.733	.102	.107	.168	.623
3	4	.141	.055	.056	.748	.107	.112	.135	.646
4	4	.142	.056	.056	.746	.107	.111	.140	.642

State 12 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.683	.092	.135	.090	.332	.255	.237	.176
2	1	.667	.153	.100	.080	.337	.262	.222	.179
3	1	.646	.236	.052	.066	.343	.272	.203	.182
4	1	.679	.107	.127	.087	.332	.257	.233	.177
1	2	.450	.147	.147	.256	.335	.121	.128	.416
2	2	.422	.167	.192	.219	.334	.140	.160	.366
3	2	.253	.288	.459	.000	.327	.249	.341	.083
4	2	.424	.165	.189	.222	.334	.139	.157	.370
1	3	.256	.110	.232	.402	.169	.205	.236	.390
2	3	.276	.114	.236	.374	.077	.112	.452	.359
3	3	.265	.112	.234	.389	.127	.163	.334	.376
4	3	.239	.106	.228	.427	.254	.292	.037	.417
1	4	.146	.061	.059	.734	.103	.108	.163	.626
2	4	.185	.116	.091	.608	.062	.067	.422	.449
3	4	.141	.053	.055	.751	.108	.113	.129	.650
4	4	.136	.047	.051	.766	.114	.118	.095	.673

Table 2.45

Month: December

Time: Midnight

State 6 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.557	.159	.149	.135	.302	.230	.163	.305
2	1	.552	.163	.151	.134	.309	.229	.154	.308
3	1	.534	.177	.159	.130	.335	.221	.123	.321
4	1	.552	.163	.151	.134	.309	.229	.154	.308
1	2	.317	.211	.259	.213	.258	.079	.226	.437
2	2	.503	.147	.001	.349	.156	.255	.272	.317
3	2	.307	.214	.273	.206	.263	.070	.224	.443
4	2	.504	.147	.000	.349	.156	.256	.272	.316
1	3	.220	.269	.113	.398	.159	.202	.190	.449
2	3	.340	.292	.000	.368	.255	.290	.157	.298
3	3	.000	.228	.319	.453	.000	.055	.245	.700
4	3	.303	.285	.035	.377	.226	.262	.167	.345
1	4	.216	.107	.171	.506	.189	.108	.056	.646
2	4	.114	.079	.123	.684	.142	.135	.199	.524
3	4	.146	.087	.138	.629	.157	.126	.155	.562
4	4	.079	.069	.107	.745	.126	.144	.249	.481

State 12 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.521	.187	.165	.127	.354	.216	.100	.330
2	1	.577	.144	.140	.139	.272	.239	.198	.291
3	1	.493	.208	.178	.121	.394	.205	.052	.349
4	1	.622	.109	.120	.149	.207	.257	.277	.259
1	2	.390	.220	.296	.194	.273	.054	.219	.454
2	2	.233	.240	.375	.152	.304	.000	.206	.490
3	2	.403	.181	.140	.276	.211	.160	.247	.382
4	2	.504	.147	.000	.349	.156	.256	.272	.316
1	3	.156	.257	.173	.414	.111	.157	.207	.525
2	3	.340	.292	.000	.368	.255	.290	.157	.298
3	3	.178	.261	.152	.409	.128	.172	.201	.499
4	3	.280	.280	.057	.383	.206	.245	.174	.375
1	4	.153	.089	.141	.617	.160	.125	.145	.570
2	4	.064	.064	.100	.772	.118	.148	.271	.463
3	4	.150	.088	.140	.622	.159	.126	.149	.566
4	4	.092	.072	.113	.723	.131	.141	.231	.497

Table 2.46

Month: December

Time: Six A.M.

State 6 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.425	.279	.111	.185	.499	.139	.150	.212
2	1	.471	.221	.138	.170	.442	.066	.089	.403
3	1	.416	.290	.106	.188	.510	.154	.161	.175
4	1	.448	.250	.124	.178	.471	.103	.119	.307
1	2	.207	.323	.204	.266	.370	.206	.083	.341
2	2	.251	.064	.258	.427	.000	.261	.367	.372
3	2	.202	.349	.199	.250	.402	.201	.059	.338
4	2	.224	.223	.225	.328	.238	.225	.185	.352
1	3	.160	.095	.270	.475	.347	.100	.100	.453
2	3	.138	.046	.206	.610	.288	.079	.079	.554
3	3	.118	.000	.145	.737	.231	.058	.060	.651
4	3	.189	.160	.358	.293	.423	.128	.127	.322
1	4	.048	.090	.181	.681	.181	.091	.108	.620
2	4	.077	.145	.304	.474	.285	.158	.166	.391
3	4	.056	.103	.211	.630	.206	.108	.122	.564
4	4	.040	.073	.144	.743	.151	.071	.091	.687

State 12 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.437	.264	.118	.181	.485	.121	.134	.260
2	1	.443	.256	.122	.179	.477	.110	.125	.288
3	1	.467	.226	.136	.171	.447	.072	.093	.388
4	1	.414	.293	.104	.189	.514	.158	.165	.163
1	2	.220	.244	.221	.315	.267	.221	.162	.350
2	2	.215	.276	.214	.395	.311	.214	.129	.346
3	2	.226	.213	.227	.334	.224	.227	.196	.353
4	2	.211	.297	.210	.282	.338	.210	.108	.344
1	3	.152	.077	.247	.524	.326	.092	.093	.489
2	3	.118	.000	.145	.737	.232	.058	.060	.650
3	3	.143	.056	.219	.582	.301	.083	.084	.532
4	3	.206	.200	.410	.184	.467	.144	.143	.246
1	4	.049	.091	.184	.676	.184	.093	.109	.614
2	4	.014	.022	.032	.932	.058	.012	.039	.891
3	4	.052	.096	.195	.657	.193	.099	.115	.593
4	4	.062	.116	.239	.583	.230	.123	.135	.512

Table 2.47

Month: December

Time: Noon

State 6 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.655	.116	.131	.098	.438	.191	.092	.279
2	1	.658	.156	.106	.080	.452	.190	.111	.247
3	1	.654	.104	.138	.104	.433	.192	.086	.289
4	1	.670	.330	.000	.000	.517	.185	.196	.102
1	2	.562	.178	.111	.149	.581	.069	.043	.307
2	2	.504	.210	.140	.146	.508	.114	.071	.307
3	2	.529	.196	.127	.148	.540	.094	.059	.307
4	2	.509	.207	.137	.147	.515	.110	.068	.307
1	3	.373	.168	.100	.359	.456	.132	.093	.319
2	3	.303	.115	.235	.347	.363	.140	.095	.402
3	3	.314	.123	.214	.349	.378	.139	.094	.389
4	3	.361	.159	.123	.357	.440	.134	.093	.333
1	4	.064	.085	.140	.711	.208	.071	.106	.615
2	4	.000	.106	.207	.687	.207	.066	.103	.624
3	4	.156	.055	.042	.747	.208	.080	.111	.601
4	4	.067	.084	.136	.713	.208	.072	.106	.614

State 12 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.655	.107	.136	.102	.434	.192	.087	.287
2	1	.658	.152	.109	.081	.451	.190	.109	.250
3	1	.670	.330	.000	.000	.517	.185	.196	.102
4	1	.658	.148	.111	.083	.450	.190	.107	.253
1	2	.554	.182	.115	.149	.571	.075	.047	.307
2	2	.575	.170	.105	.150	.597	.059	.037	.307
3	2	.652	.127	.068	.153	.694	.000	.000	.306
4	2	.451	.240	.165	.144	.443	.154	.096	.307
1	3	.374	.169	.098	.359	.457	.132	.093	.318
2	3	.150	.000	.530	.320	.178	.155	.098	.569
3	3	.352	.152	.141	.355	.427	.134	.094	.345
4	3	.379	.172	.089	.360	.463	.132	.093	.312
1	4	.085	.078	.117	.720	.208	.074	.107	.611
2	4	.079	.080	.124	.717	.208	.073	.106	.613
3	4	.067	.084	.136	.713	.208	.072	.106	.614
4	4	.065	.085	.138	.712	.208	.072	.106	.614

Table 2.48

Month: December

Time: Six P.M.

State 6 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.644	.168	.074	.114	.400	.225	.166	.209
2	1	.692	.061	.072	.175	.519	.141	.121	.219
3	1	.646	.163	.074	.117	.405	.222	.164	.209
4	1	.719	.000	.071	.210	.585	.095	.095	.225
1	2	.469	.146	.105	.280	.369	.139	.129	.363
2	2	.464	.153	.117	.266	.393	.132	.111	.364
3	2	.460	.160	.128	.252	.416	.126	.093	.365
4	2	.448	.177	.158	.217	.477	.109	.045	.369
1	3	.216	.217	.105	.462	.130	.109	.214	.547
2	3	.212	.219	.102	.467	.123	.109	.210	.548
3	3	.331	.156	.197	.316	.353	.107	.334	.206
4	3	.295	.175	.168	.362	.282	.107	.296	.315
1	4	.122	.082	.067	.729	.173	.129	.092	.606
2	4	.183	.137	.000	.680	.158	.217	.067	.558
3	4	.115	.076	.075	.734	.174	.119	.095	.612
4	4	.098	.060	.094	.748	.179	.094	.102	.625

State 12 hours earlier	Present State	State six hours later				State 12 hours later			
		1	2	3	4	1	2	3	4
1	1	.659	.136	.073	.132	.436	.200	.152	.212
2	1	.687	.072	.072	.169	.507	.150	.125	.218
3	1	.661	.130	.073	.136	.442	.195	.150	.213
4	1	.666	.120	.073	.141	.454	.187	.145	.214
1	2	.448	.176	.157	.210	.473	.110	.048	.369
2	2	.513	.083	.000	.404	.174	.194	.281	.351
3	2	.466	.150	.113	.271	.384	.135	.118	.363
4	2	.436	.194	.185	.185	.535	.093	.000	.372
1	3	.213	.218	.102	.467	.123	.109	.211	.557
2	3	.339	.152	.203	.306	.369	.107	.343	.181
3	3	.232	.208	.118	.442	.160	.109	.230	.501
4	3	.319	.162	.188	.331	.330	.107	.322	.241
1	4	.149	.106	.038	.707	.166	.167	.082	.585
2	4	.032	.000	.167	.801	.195	.000	.128	.677
3	4	.094	.056	.099	.751	.180	.087	.104	.629
4	4	.114	.074	.077	.735	.175	.117	.095	.613

Table 2.49
Values of the functions
 $\alpha_1, \alpha_2, \beta_1, \beta_2$
for January, Midnight
Present State 1

State 6 hours earlier	α_1	α_2	State 6 hours later	β_1	β_2
1	1.000	.000	1	.599	.559
2	.043	.957	2	.164	.118
3	.187	.813	3	.144	.171
4	.000	1.000	4	.093	.152

State 12 hours earlier	α_1	α_2	State 12 hours later	β_1	β_2
1	.787	.213	1	.211	.470
2	.617	.383	2	.295	.121
3	.665	.335	3	.158	.154
4	.260	.740	4	.336	.255

3. Reliability of the estimates. The reliability of the estimates of conditional probabilities given in Section 2 depends on two factors:

1. The quality of the fit of the model to the data;
2. The number of observations.

The quality of the fit of the model to the data is measured by the value of

$$\chi^2 = \sum_{i=1}^8 \sum_{j=1}^8 (n_{ij} - \hat{p}_{ij} N)^2 / \hat{p}_{ij} N$$

where $N = \sum_{i=1}^8 \sum_{j=1}^8 n_{ij}$ and the \hat{p}_{ij} are values of p_{ij} which minimize

the expression in (2.2) subject to (2.1). Consider the 64 cells given by a past (one of the A_i) and a future (one of the B_j). Each time the fixed observation occurs at a given fixed time and month, that observation is placed in four of the 64 cells according to the two pasts A_i and futures B_j which occurred. The 8 x 8 matrix (n_{ij}) is the matrix of counts in these cells.

If the assignment of observations to cells were such that each observation were placed in a single cell, the minimum value of χ^2 would have, if N were large and the model is correct, approximately a χ^2 distribution. The fact that each observation falls in four cells affects the quality of this approximation. Also, the appropriate number of degrees of freedom will be slightly affected. Since this affect is not precisely known, we will ignore it.

The number of degrees of freedom is given by $m = a - b - c$ where a is the number of cells, b is the number of independent linear restrictions among the n_{ij} , and c is the number of linearly independent parameters in the model. Now $a = 64$. The n_{ij} satisfy

$$(3.1) \quad \sum_{j=1}^4 n_{ij} = \sum_{j=5}^8 n_{ij} \quad (i = 1, \dots, 8)$$

and

$$(3.2) \quad \sum_{i=1}^4 n_{ij} = \sum_{i=5}^8 n_{ij} \quad (j = 1, \dots, 8)$$

Restrictions (3.1) follow from the fact that A_1, A_2, A_3, A_4 are mutually exclusive and exhaustive sets of pasts as are A_5, A_6, A_7, A_8 . A similar observation for the B_j yields (3.2). Of these 16 equations, any one can be derived from the other 15 so $b = 15$. The parameters of the model are the $\alpha_k(A_i, \epsilon)$ and $\beta_k(B_j, \epsilon)$ in (2.1) for $k = 1, 2$; $i = 1, \dots, 8$; and $j = 1, \dots, 8$. Thus there are 32 parameters. The $\alpha_k(A_i, \epsilon)$ are probabilities satisfying

$$(3.3) \quad \sum_{i=1}^4 [\alpha_1(A_i, \epsilon) + \alpha_2(A_i, \epsilon)] \\ = \sum_{i=5}^8 [\alpha_1(A_i, \epsilon) + \alpha_2(A_i, \epsilon)]$$

and the $\beta_k(B_j, \epsilon)$ are conditional probabilities satisfying

$$(3.4) \quad \sum_{j=1}^4 \beta_k(B_j, \epsilon) = 1 \quad (k = 1, 2)$$

and

$$\sum_{j=5}^8 \beta_k(B_j, \epsilon) = 1 \quad (k = 1, 2)$$

These are 5 linearly independent restrictions so $c = 27$. Thus finally, $n = 22$.

If the model is not correct, the distribution of the minimum value of χ^2 would not have a χ^2 distribution. In fact the value would tend to be larger than typical for variables with a χ^2 distribution. Thus a large value of this minimum relative to the number of degrees of freedom is indicative of a poor fit of the model to the data while small or moderate values indicate a good fit. The largest value obtained is 20.483 for the case of state 4 at Midnight in February. Since over half of all observations from χ^2 distributions with 22 degrees of freedom are at least this large one would take this as evidence that the model fits well. Inspection of tables 3.1 to 3.12 shows that most of the values are considerably smaller than this.

A model may fit well, but the data may be too sparse to provide accurate estimates of the parameters. In our case, the estimates of p_{ij} depend heavily on n_{ij} and to a lesser extent on the counts in other cells.

Accuracy of the estimates requires large numbers of observations and, in particular, large values of $\sum_{j=1}^4 n_{ij}$. The total number of observations is $\sum_{i=1}^4 \sum_{j=1}^4 n_{ij}$. This follows by the same reasoning that yields (3.1) and (3.2). Table 3.1 to 3.12 give the values of $\sum_{j=1}^4 n_{ij}$ for $i=1, \dots, 8$ and the values of the minimum of the expression in (2.2) subject to (2.1). Each table is entered with the present time, present state, and, for the values of $\sum_{j=1}^4 n_{ij}$ with the state six or twelve hours earlier. The states are numbered as in tables 2.1 to 2.48.

We return to the examples of Section 1. We observed the sky to be partially cloudy at midnight in January. In table 3.1 we refer

to the column for state 2 at midnight. We see that the χ^2 value is 0.806 so the fit is very good. However, due to small numbers of observations, the estimates are not reliable. The situation is much better for the case of a clear sky at midnight.

Tables 3.1 to 3.12 to follow.

Table 3.1

Month: January

State 6 hrs earlier	State at midnight				State at six A.M.			
	1	2	3	4	1	2	3	4
1	85	18	10	27	93	23	25	19
2	27	7	12	16	15	11	5	12
3	22	6	13	22	7	8	7	27
4	26	12	14	179	17	10	28	189
State 12 hrs earlier								
1	48	14	8	29	63	22	20	35
2	37	7	7	27	19	9	8	26
3	22	7	10	30	17	7	8	31
4	53	15	24	158	33	14	29	155
χ^2	6.894	8.806	9.614	15.885	9.241	6.772	2.839	10.664
State 6 hrs earlier								
	State at noon				State at six P.M.			
	1	2	3	4	1	2	3	4
1	56	37	20	19	69	9	10	12
2	17	13	11	11	37	13	14	18
3	15	9	10	31	18	17	9	23
4	12	23	26	186	19	21	29	178
State 12 hrs earlier								
1	52	35	25	48	67	20	18	27
2	12	10	7	14	14	7	9	22
3	6	6	7	30	21	9	8	27
4	30	31	28	155	41	24	27	155
χ^2	11.459	7.366	15.412	13.919	8.201	6.349	11.266	10.742

Table 3.2

Month: February

State 6 hrs earlier	State at midnight				State at 6 A. M.			
	1	2	3	4	1	2	3	4
1	93	16	10	15	88	30	30	14
2	32	11	9	26	11	10	10	16
3	20	12	8	25	9	7	10	13
4	17	8	12	138	10	15	21	158
State 12 hrs earlier								
1	53	11	9	16	61	20	24	29
2	32	10	5	31	20	11	14	33
3	35	7	14	30	15	15	13	22
4	42	19	11	127	22	16	20	117
\bar{x}^2	7.886	5.569	6.600	20.483	10.175	8.141	8.572	8.159
State 6 hrs earlier								
1	52	24	22	20	54	20	8	4
2	16	15	19	12	33	17	9	14
3	9	17	16	29	25	22	18	26
4	9	17	34	141	16	23	34	129
State 12 hrs earlier								
1	46	34	33	49	52	26	17	23
2	13	11	10	13	23	9	12	18
3	7	8	10	14	18	12	9	32
4	20	20	38	126	35	35	31	100
\bar{x}^2	11.792	7.512	4.837	9.449	13.468	11.671	12.622	13.106

Table 3.3

Month: March

State 6 hrs earlier	State at midnight				State at 6 A.M.			
	1	2	3	4	1	2	3	4
1	88	9	12	13	85	33	30	18
2	38	10	14	26	15	11	12	16
3	20	18	16	38	15	10	12	29
4	20	17	24	163	16	21	28	175
State 12 hrs earlier								
1	56	10	15	22	54	24	22	22
2	38	5	11	22	23	13	16	36
3	38	16	13	40	19	11	21	41
4	34	23	27	156	35	27	23	139
χ^2	6.351	10.040	16.291	12.797	12.272	5.526	10.209	6.715
State 6 hrs earlier								
1	64	33	22	12	59	23	15	8
2	18	14	21	22	32	21	10	17
3	16	17	21	29	22	16	36	29
4	7	16	39	176	13	23	32	171
State 12 hrs earlier								
1	63	35	30	38	55	24	22	30
2	10	17	12	15	21	17	18	19
3	9	7	14	36	27	14	11	31
4	23	21	47	150	23	28	42	145
χ^2	10.718	11.061	8.595	7.379	9.231	8.654	7.881	10.381

Table 3.4

Month: April

State 6 hrs earlier	State at midnight				State at 6 A.M.			
	1	2	3	4	1	2	3	4
1	47	6	12	7	57	27	22	24
2	41	19	13	12	15	20	12	15
3	27	16	23	55	16	8	21	23
4	15	21	20	176	18	17	28	187
State 12 hrs earlier								
1	35	12	12	21	21	21	18	12
2	29	7	11	29	26	11	14	34
3	25	22	22	44	30	13	22	56
4	41	21	23	156	29	27	29	147
χ^2	8.772	7.141	8.361	10.184	6.185	3.747	3.609	8.748
State 6 hrs earlier								
	State at noon				State at 6 P.M.			
	1	2	3	4	1	2	3	4
1	44	30	18	14	28	22	21	11
2	19	17	19	17	21	16	23	15
3	8	14	34	27	15	25	37	40
4	11	14	46	178	8	22	39	167
State 12 hrs earlier								
1	36	24	37	33	28	29	24	25
2	14	10	16	22	17	11	20	24
3	10	14	21	23	10	13	30	30
4	22	27	43	158	17	32	46	154
χ^2	6.555	7.098	7.865	13.088	10.112	3.669	6.770	10.043

Table 3.5

Months: May

State 6 hrs earlier	State at midnight				State at 6 A.M.			
	1	2	3	4	1	2	3	4
1	63	4	2	7	69	34	29	21
2	31	16	20	11	12	18	11	14
3	30	14	29	50	6	13	15	40
4	29	21	23	177	14	11	29	191
State 12 hrs earlier								
1	38	10	9	20	32	16	11	17
2	33	9	14	29	16	24	16	22
3	44	19	22	50	26	16	21	60
4	38	17	29	146	27	20	36	167
χ^2	7.104	7.584	10.465	4.006	13.559	11.509	11.876	4.426
State 6 hrs earlier	State at noon				State at 6 P.M.			
	1	2	3	4	1	2	3	4
1	40	27	32	2	36	15	17	7
2	16	19	25	16	18	24	24	20
3	9	12	37	26	15	25	42	52
4	10	28	40	188	7	18	42	165
State 12 hrs earlier								
1	42	32	46	33	24	21	31	25
2	4	11	21	19	12	13	24	27
3	12	9	19	34	10	13	25	36
4	17	34	48	146	30	35	45	156
χ^2	7.949	7.675	7.267	13.939	3.377	14.037	2.962	10.026

Table 3.6

Month: June

State 6 hrs earlier	State at midnight				State at 6 A.M.			
	1	2	3	4	1	2	3	4
1	46	18	10	4	50	41	24	17
2	42	21	19	15	33	17	15	18
3	33	26	38	48	13	17	28	43
4	11	18	34	127	7	13	36	138
State 12 hrs earlier								
1	19	14	7	11	30	22	11	15
2	60	22	28	21	26	16	26	29
3	38	25	41	46	24	38	27	56
4	15	22	25	116	23	12	39	116
χ^2	8.127	9.141	13.272	11.215	9.576	10.126	4.196	12.555
State 6 hrs earlier	State at noon				State at 6 P.M.			
	1	2	3	4	1	2	3	4
1	23	46	32	2	20	12	12	6
2	15	32	27	14	34	45	37	14
3	8	25	41	29	16	26	63	50
4	4	27	55	130	6	16	33	120
State 12 hrs earlier								
1	20	50	45	17	28	27	34	14
2	15	24	22	22	12	28	29	19
3	4	31	31	35	19	15	31	38
4	11	25	57	101	17	29	51	119
χ^2	10.511	6.313	7.312	4.389	10.485	7.757	6.627	8.213

Table 3.7

Month: July

State 6 hrs earlier	State at midnight				State at 6 A.M.			
	1	2	3	4	1	2	3	4
1	44	16	16	3	56	44	33	25
2	51	29	18	19	22	19	24	22
3	44	29	44	45	18	18	27	51
4	19	13	36	101	3	16	26	123
State 12 hrs earlier								
1	18	8	8	3	31	21	15	12
2	50	33	30	31	26	21	26	44
3	52	34	46	55	29	31	42	60
4	38	12	30	79	13	24	27	105
χ^2	8.755	13.477	10.982	5.131	8.379	8.754	11.247	4.302
State 6 hrs earlier	State at noon				State at 6 P.M.			
	1	2	3	4	1	2	3	4
1	16	49	34	0	20	8	8	1
2	12	42	32	11	37	45	39	22
3	5	22	53	30	18	42	75	51
4	4	30	67	120	3	17	38	103
State 12 hrs earlier								
1	14	57	64	23	22	32	30	15
2	6	27	35	19	29	27	26	15
3	11	29	48	26	12	16	41	41
4	6	30	39	93	15	37	63	106
χ^2	5.986	6.351	9.702	11.597	10.256	7.696	7.409	11.862

Table 3.8

Month: August

State 6 hrs earlier	State at midnight				State at 6 A.M.			
	1	2	3	4	1	2	3	4
1	63	18	13	3	79	53	22	20
2	58	31	16	21	24	17	25	24
3	39	26	30	46	20	8	21	30
4	14	15	20	114	9	11	28	136
State 12 hrs earlier								
1	33	9	11	11	37	27	15	18
2	60	32	16	35	36	32	25	33
3	50	36	28	55	38	19	26	58
4	31	13	24	83	21	11	30	101
χ^2	14.604	9.859	8.044	7.987	4.363	13.291	5.464	11.703
State 6 hrs earlier	State at noon				State at 6 P.M.			
	1	2	3	4	1	2	3	4
1	40	55	29	8	28	26	8	2
2	13	36	33	7	37	49	41	17
3	8	25	40	23	25	38	57	46
4	3	28	64	115	9	16	34	94
State 12 hrs earlier								
1	39	63	47	25	40	43	36	13
2	10	29	35	16	18	30	23	18
3	8	18	25	28	15	21	34	26
4	7	34	59	84	26	35	47	102
χ^2	9.201	8.590	13.858	8.023	8.209	19.666	5.505	14.248

Table 3.9

Month: September

State 6 hrs earlier	State at midnight				State at 6 A.M.			
	1	2	3	4	1	2	3	4
1	101	14	14	7	110	39	24	17
2	43	26	16	18	20	14	17	21
3	26	24	29	33	12	19	26	27
4	20	8	25	106	10	8	24	122
State 12 hrs earlier								
1	71	22	11	15	72	23	19	22
2	56	20	16	19	37	22	17	27
3	37	21	35	38	23	17	27	45
4	26	9	22	92	20	18	28	93
χ^2	10.828	13.526	7.454	10.840	13.329	8.903	12.750	11.626
State 6 hrs earlier								
1	63	55	26	8	75	25	18	1
2	30	18	25	7	39	39	17	15
3	17	21	26	27	18	28	45	39
4	9	16	53	109	5	7	31	108
State 12 hrs earlier								
1	77	58	36	19	71	39	27	15
2	12	19	23	18	25	19	22	14
3	13	11	23	37	19	18	26	28
4	17	22	48	77	22	23	36	106
χ^2	2.716	4.763	20.116	8.709	4.835	8.492	7.421	15.537

Table 3.10

Month: October

State 6 hrs earlier	State at midnight				State at 6 A.M.			
	1	2	3	4	1	2	3	4
1	147	17	17	12	113	56	34	20
2	33	15	20	10	13	8	32	14
3	26	14	15	26	10	7	24	27
4	17	21	16	121	8	11	19	131
State 12 hrs earlier								
1	89	18	15	14	82	49	35	27
2	55	10	12	16	20	9	26	23
3	44	15	17	35	19	8	21	33
4	35	24	24	104	23	16	27	100
X ²	10.830	4.823	12.815	10.044	18.977	8.002	10.001	11.729
State 6 hrs earlier	State at noon				State at 6 P.M.			
	1	2	3	4	1	2	3	4
1	80	43	15	6	97	25	9	5
2	29	26	17	10	47	20	16	11
3	16	20	37	36	30	22	29	29
4	11	5	41	135	16	14	29	128
State 12 hrs earlier								
1	95	54	42	32	91	27	21	5
2	19	11	16	21	39	15	15	13
3	8	11	21	28	35	13	19	42
4	14	18	31	106	25	26	28	113
X ²	10.893	12.260	10.778	4.155	9.383	4.685	14.911	11.180

Table 3.11

Month: November

State 6 hrs earlier	State at midnight				State at 6 A.M.			
	1	2	3	4	1	2	3	4
1	94	18	15	13	68	47	38	17
2	26	14	18	15	11	14	15	14
3	21	9	19	36	15	8	17	26
4	29	13	14	156	10	20	28	162
State 12 hrs earlier								
1	44	8	13	15	44	38	33	25
2	37	15	9	31	23	11	15	24
3	36	14	17	42	14	17	20	34
4	53	17	27	132	23	23	30	136
χ^2	4.757	6.615	10.654	9.033	11.171	5.554	6.921	8.304
State 6 hrs earlier	State at noon				State at 6 P.M.			
	1	2	3	4	1	2	3	4
1	37	29	29	8	54	14	9	4
2	19	23	24	23	38	16	17	21
3	13	23	23	39	32	19	28	30
4	12	17	33	157	22	23	28	154
State 12 hrs earlier								
1	41	39	43	47	42	18	21	22
2	10	15	15	14	36	12	16	25
3	10	11	18	26	29	12	18	39
4	20	27	33	140	39	30	27	123
χ^2	5.251	5.176	3.249	9.966	4.766	10.475	12.028	11.805

Table 3.12

Month: December

State 6 hrs earlier	State at midnight				State at 6 A.M.			
	1	2	3	4	1	2	3	4
1	111	22	13	22	99	29	27	24
2	30	10	7	15	22	11	10	15
3	17	12	11	25	11	13	5	19
4	21	14	17	149	22	16	25	216
State 12 hrs earlier								
1	48	21	10	26	78	31	24	35
2	50	8	5	27	28	8	4	90
3	41	13	10	33	15	8	18	24
4	40	16	23	125	33	22	21	125
χ^2	10.401	8.928	6.756	6.432	5.087	8.305	6.954	7.124
State 6 hrs earlier	State at noon				State at 6 P.M.			
	1	2	3	4	1	2	3	4
1	67	41	18	28	69	15	12	9
2	15	18	15	21	47	17	11	13
3	11	7	19	30	33	14	15	34
4	12	22	44	128	15	17	27	158
State 12 hrs earlier								
1	55	41	28	55	75	19	21	39
2	13	8	14	23	20	15	10	24
3	8	10	9	21	24	7	7	29
4	29	29	45	108	43	22	27	112
χ^2	11.842	8.095	6.344	2.275	10.003	15.213	9.050	6.868

4. Further suggested work. Further research suggested by the results of this contract fall into two main categories, that suggested by work reported here and that suggested by work reported previously by Fox. We shall discuss the former first.

The present model was merely one of several suggested and the only one which proved both tractable and good fitting. If this model can be given a physical basis a deeper insight would be obtained into the mechanism by which cloud cover evolves. In physical terms one wishes to identify the eight states of the Markov process $\{Y_n\}$. Thus, one wishes a physical process with eight states for which there is a natural mapping $X_n = f(Y_n)$ in which $\{X_n\}$ is the four state cloud cover process and for each state ϵ of $\{X_n\}$, there exists states δ_1 and δ_2 of $\{Y_n\}$ with $f(\delta_1) = f(\delta_2) = \epsilon$. If we have observations on $\{Y_n\}$ we can then attempt to fit a Markov chain and see if the resulting estimates of transition probabilities are consistent with those given here.

As time passes more observations of cloud cover will become available. The computations should be repeated in order to improve reliability of those estimates which are based on small numbers of observations. Also as more observations become available the number of pasts and futures can be increased. If we were to double the number of cells considered we would have to have at least twice as many observations as are presently available.

The model fits well for Boston data. Would it fit as well for other localities? Data for every six hours were used. Would the model fit as well for hourly data? The necessary computations should be made.

Fox suggested a model for the behaviour of fair weather cumulus clouds based on physically known facts. This model should be improved

as indicated in [3]. In addition, models for the evolution of other types of clouds should be developed. These models should, if possible, be aggregated into an overall model for the evolution of cloud cover.

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