

程式設計理念和規格書

第二題

程式設計理念：

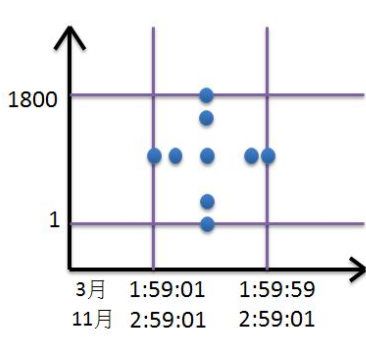
Testing cases 分別由採取不同測法的程式產生出來，再傳到計算 charge 的程式判斷是否經過 daylight saving time 和 total charge，印出測試結果。

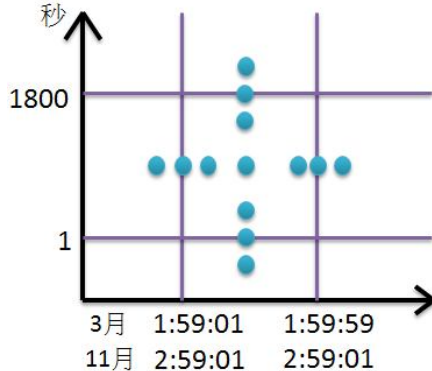
系統規格：

A. boundary testing

測試目的：測試在 bound 範圍中,系統的可靠度

測試規格：

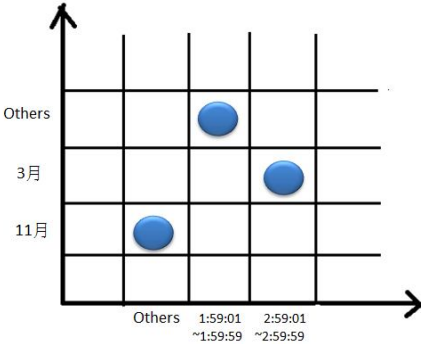
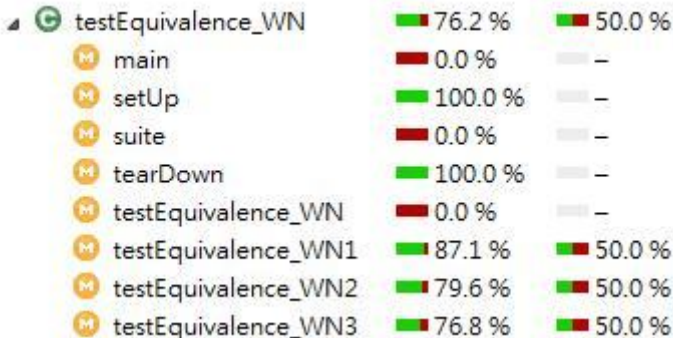
Boundary	<ol style="list-style-type: none">分作 3 月及 11 月作不同的 boundary3 月的時間 bound: 1~1800 分鐘 因為題目 bill 的計費方式最小單位為分鐘 故通話時間不能超過 30hr 即換算成 1800 分鐘3 月份的日光節約時間 bound: 考慮 3 月的 first Sunday, 在 1:59:01~1:59:59 通話結束時, 因為最小單位是分鐘, 所以 01 秒到 59 秒皆會自動進位, 歸為 3:00:0011 月的時間 bound: 1~1800 分鐘11 月份的日光節約時間 bound: 考慮 11 月的 first Sunday, 在 2:59:01~2:59:59 通話結束時, 因為最小單位是分鐘, 所以 01 秒到 59 秒皆會自動進位, 歸回 2:00:00如下圖所示:  <ol style="list-style-type: none">Coverage 如下:
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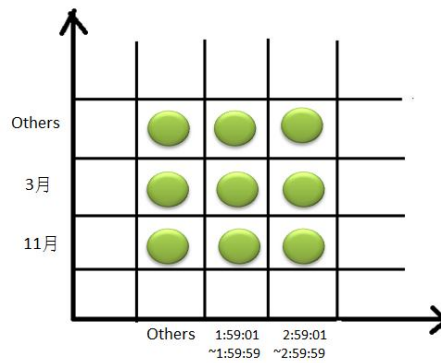
	<table><tr><th>Name</th><th>Statement</th><th>Branch</th></tr><tr><td>testBoundary</td><td>81.9 %</td><td>62.1 %</td></tr><tr><td> Bills</td><td>80.0 %</td><td>74.4 %</td></tr><tr><td> MarchSunday</td><td>87.5 %</td><td>75.0 %</td></tr><tr><td> NovemberSunday</td><td>87.5 %</td><td>75.0 %</td></tr><tr><td> bills</td><td>66.7 %</td><td>61.1 %</td></tr><tr><td> dstMarch</td><td>72.7 %</td><td>71.4 %</td></tr><tr><td> dstNovember</td><td>80.0 %</td><td>77.3 %</td></tr><tr><td> duration</td><td>100.0 %</td><td>100.0 %</td></tr><tr><td> Data</td><td>0.0 %</td><td>—</td></tr><tr><td> testBoundary</td><td>81.6 %</td><td>50.0 %</td></tr><tr><td> main</td><td>0.0 %</td><td>—</td></tr><tr><td> setUp</td><td>100.0 %</td><td>—</td></tr><tr><td> suite</td><td>0.0 %</td><td>—</td></tr><tr><td> tearDown</td><td>100.0 %</td><td>—</td></tr><tr><td> testBoundary</td><td>0.0 %</td><td>—</td></tr><tr><td> testBoundary1</td><td>95.8 %</td><td>50.0 %</td></tr><tr><td> testBoundary10</td><td>95.7 %</td><td>50.0 %</td></tr><tr><td> testBoundary11</td><td>90.0 %</td><td>50.0 %</td></tr><tr><td> testBoundary12</td><td>90.0 %</td><td>50.0 %</td></tr><tr><td> testBoundary13</td><td>90.0 %</td><td>50.0 %</td></tr><tr><td> testBoundary14</td><td>90.0 %</td><td>50.0 %</td></tr><tr><td> testBoundary15</td><td>90.9 %</td><td>50.0 %</td></tr><tr><td> testBoundary16</td><td>90.0 %</td><td>50.0 %</td></tr><tr><td> testBoundary17</td><td>91.7 %</td><td>50.0 %</td></tr><tr><td> testBoundary18</td><td>90.9 %</td><td>50.0 %</td></tr><tr><td> testBoundary2</td><td>90.0 %</td><td>50.0 %</td></tr><tr><td> testBoundary3</td><td>90.0 %</td><td>50.0 %</td></tr><tr><td> testBoundary4</td><td>90.0 %</td><td>50.0 %</td></tr><tr><td> testBoundary5</td><td>90.0 %</td><td>50.0 %</td></tr><tr><td> testBoundary6</td><td>90.9 %</td><td>50.0 %</td></tr><tr><td> testBoundary7</td><td>90.0 %</td><td>50.0 %</td></tr><tr><td> testBoundary8</td><td>91.7 %</td><td>50.0 %</td></tr><tr><td> testBoundary9</td><td>90.9 %</td><td>50.0 %</td></tr></table>	Name	Statement	Branch	testBoundary	81.9 %	62.1 %	Bills	80.0 %	74.4 %	MarchSunday	87.5 %	75.0 %	NovemberSunday	87.5 %	75.0 %	bills	66.7 %	61.1 %	dstMarch	72.7 %	71.4 %	dstNovember	80.0 %	77.3 %	duration	100.0 %	100.0 %	Data	0.0 %	—	testBoundary	81.6 %	50.0 %	main	0.0 %	—	setUp	100.0 %	—	suite	0.0 %	—	tearDown	100.0 %	—	testBoundary	0.0 %	—	testBoundary1	95.8 %	50.0 %	testBoundary10	95.7 %	50.0 %	testBoundary11	90.0 %	50.0 %	testBoundary12	90.0 %	50.0 %	testBoundary13	90.0 %	50.0 %	testBoundary14	90.0 %	50.0 %	testBoundary15	90.9 %	50.0 %	testBoundary16	90.0 %	50.0 %	testBoundary17	91.7 %	50.0 %	testBoundary18	90.9 %	50.0 %	testBoundary2	90.0 %	50.0 %	testBoundary3	90.0 %	50.0 %	testBoundary4	90.0 %	50.0 %	testBoundary5	90.0 %	50.0 %	testBoundary6	90.9 %	50.0 %	testBoundary7	90.0 %	50.0 %	testBoundary8	91.7 %	50.0 %	testBoundary9	90.9 %	50.0 %
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Robustness	<div>1. 考慮方式與 boundary 相似</div> <div>2. 多考慮了在 bound 外的部分</div> <div>3. 如下圖所示:</div> <div></div> <div>4. Coverage 如下:</div> <table><tr><th>Name</th><th>Statement</th><th>Branch</th></tr><tr><td>testBoundary</td><td>81.9 %</td><td>62.1 %</td></tr><tr><td> Bills</td><td>80.0 %</td><td>74.4 %</td></tr><tr><td> MarchSunday</td><td>87.5 %</td><td>75.0 %</td></tr><tr><td> NovemberSunday</td><td>87.5 %</td><td>75.0 %</td></tr><tr><td> bills</td><td>66.7 %</td><td>61.1 %</td></tr><tr><td> dstMarch</td><td>72.7 %</td><td>71.4 %</td></tr><tr><td> dstNovember</td><td>80.0 %</td><td>77.3 %</td></tr><tr><td> duration</td><td>100.0 %</td><td>100.0 %</td></tr><tr><td> Data</td><td>0.0 %</td><td>—</td></tr><tr><td> testBoundary</td><td>81.6 %</td><td>50.0 %</td></tr><tr><td> main</td><td>0.0 %</td><td>—</td></tr><tr><td> setUp</td><td>100.0 %</td><td>—</td></tr><tr><td> suite</td><td>0.0 %</td><td>—</td></tr><tr><td> tearDown</td><td>100.0 %</td><td>—</td></tr><tr><td> testBoundary</td><td>0.0 %</td><td>—</td></tr><tr><td> testBoundary1</td><td>95.8 %</td><td>50.0 %</td></tr><tr><td> testBoundary10</td><td>95.7 %</td><td>50.0 %</td></tr><tr><td> testBoundary11</td><td>90.0 %</td><td>50.0 %</td></tr><tr><td> testBoundary12</td><td>90.0 %</td><td>50.0 %</td></tr><tr><td> testBoundary13</td><td>90.0 %</td><td>50.0 %</td></tr><tr><td> testBoundary14</td><td>90.0 %</td><td>50.0 %</td></tr><tr><td> testBoundary15</td><td>90.9 %</td><td>50.0 %</td></tr><tr><td> testBoundary16</td><td>90.0 %</td><td>50.0 %</td></tr><tr><td> testBoundary17</td><td>91.7 %</td><td>50.0 %</td></tr><tr><td> testBoundary18</td><td>90.9 %</td><td>50.0 %</td></tr><tr><td> testBoundary2</td><td>90.0 %</td><td>50.0 %</td></tr><tr><td> testBoundary3</td><td>90.0 %</td><td>50.0 %</td></tr><tr><td> testBoundary4</td><td>90.0 %</td><td>50.0 %</td></tr><tr><td> testBoundary5</td><td>90.0 %</td><td>50.0 %</td></tr><tr><td> testBoundary6</td><td>90.9 %</td><td>50.0 %</td></tr><tr><td> testBoundary7</td><td>90.0 %</td><td>50.0 %</td></tr><tr><td> testBoundary8</td><td>91.7 %</td><td>50.0 %</td></tr><tr><td> testBoundary9</td><td>90.9 %</td><td>50.0 %</td></tr></table>	Name	Statement	Branch	testBoundary	81.9 %	62.1 %	Bills	80.0 %	74.4 %	MarchSunday	87.5 %	75.0 %	NovemberSunday	87.5 %	75.0 %	bills	66.7 %	61.1 %	dstMarch	72.7 %	71.4 %	dstNovember	80.0 %	77.3 %	duration	100.0 %	100.0 %	Data	0.0 %	—	testBoundary	81.6 %	50.0 %	main	0.0 %	—	setUp	100.0 %	—	suite	0.0 %	—	tearDown	100.0 %	—	testBoundary	0.0 %	—	testBoundary1	95.8 %	50.0 %	testBoundary10	95.7 %	50.0 %	testBoundary11	90.0 %	50.0 %	testBoundary12	90.0 %	50.0 %	testBoundary13	90.0 %	50.0 %	testBoundary14	90.0 %	50.0 %	testBoundary15	90.9 %	50.0 %	testBoundary16	90.0 %	50.0 %	testBoundary17	91.7 %	50.0 %	testBoundary18	90.9 %	50.0 %	testBoundary2	90.0 %	50.0 %	testBoundary3	90.0 %	50.0 %	testBoundary4	90.0 %	50.0 %	testBoundary5	90.0 %	50.0 %	testBoundary6	90.9 %	50.0 %	testBoundary7	90.0 %	50.0 %	testBoundary8	91.7 %	50.0 %	testBoundary9	90.9 %	50.0 %
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B. equivalence classes

測試目的：測試在各區間範圍內的(valid / invalid)的可靠度

測試規格：

Weak normal	<ol style="list-style-type: none"> 考慮日光節約時間 3 月與 11 月 判斷潤年. 平年 判斷 3 月與 11 月的第一周日期 12 月分區分成三個區塊 (3 月. 11 月. 其他月份), 因為測試下, 只會有 3 月與十一月的日光節約時間調整, 剩下其他月份(1.2.4.5.6.7.8.9.10.12 月)皆一樣 上述四點為 weak normal 的縱軸條件 考慮題目給的條件: bill 以分鐘為單位做計算 故 bound 的範圍也將秒鐘無條件進位做計算 判斷出 3 月第一周的 1:59:01 到 1:59:59 為 bound 1:59:01 到 1:59:59 => 可進位為 2:00:00 (即 pass 節約時間) 11 月則是第一周的 2:59:01 到 2:59:59 為 bound 上述 6-9 點為 weak normal 的橫軸條件 示意圖如下:  <ol style="list-style-type: none"> Coverage: 
Strong normal	<ol style="list-style-type: none"> 考慮的部分與 weak normal 相同 示意圖如下:

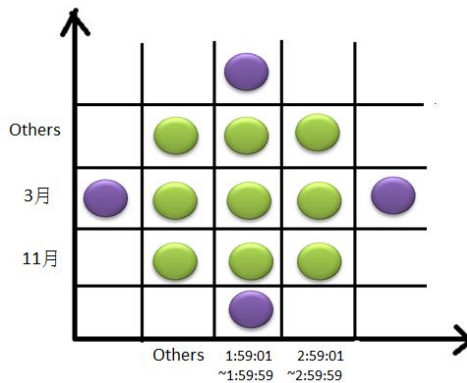


3. Coverage:

Name	Statement	Branch
testEquivalence	74.9 %	52.4 %
Bills	96.9 %	89.5 %
MarchSunday	100.0 %	100.0 %
NovemberSunday	100.0 %	100.0 %
bills	100.0 %	100.0 %
dstMarch	90.9 %	82.1 %
dstNovember	90.0 %	86.4 %
duration	100.0 %	90.0 %
Data	-	-
testEquivalence_SN	74.8 %	50.0 %
main	0.0 %	-
setUp	100.0 %	-
suite	0.0 %	-
tearDown	100.0 %	-
testEquivalence_SN	0.0 %	-
testEquivalence_SN1	85.7 %	50.0 %
testEquivalence_SN2	78.0 %	50.0 %
testEquivalence_SN3	75.4 %	50.0 %
testEquivalence_SN4	72.4 %	50.0 %
testEquivalence_SN5	72.4 %	50.0 %
testEquivalence_SN6	79.6 %	50.0 %
testEquivalence_SN7	80.4 %	50.0 %
testEquivalence_SN8	76.0 %	50.0 %
testEquivalence_SN9	76.9 %	50.0 %

Weak robust

- 1.在各個不同的範圍外加上一筆測試資料
- 2.考慮縱軸月份的範圍 invalid 的部分,大於 12 月,或負數月 (例如:13 月, -1 月)
- 3.橫軸考慮 invalid 的小時,例如: 25:57:78, -3:21:-10
- 4.因此比 strong 多取 4 組 case data
- 5.示意圖如下:



6. Coverage

	<div><div><div><div><div><div></div><div>testEquivalence_WR</div></div><div><div></div><div>74.5 %</div><div>50.0 %</div></div></div><div><div></div><div>main</div><div><div></div><div>0.0 %</div><div>—</div></div></div><div><div></div><div>setUp</div><div><div></div><div>100.0 %</div><div>—</div></div></div><div><div></div><div>suite</div><div><div></div><div>0.0 %</div><div>—</div></div></div><div><div></div><div>tearDown</div><div><div></div><div>100.0 %</div><div>—</div></div></div><div><div></div><div>testEquivalence_WR</div><div><div></div><div>0.0 %</div><div>—</div></div></div><div><div></div><div>testEquivalence_WR1</div><div><div></div><div>85.7 %</div><div>50.0 %</div></div></div><div><div></div><div>testEquivalence_WR10</div><div><div></div><div>74.5 %</div><div>50.0 %</div></div></div><div><div></div><div>testEquivalence_WR11</div><div><div></div><div>71.9 %</div><div>50.0 %</div></div></div><div><div></div><div>testEquivalence_WR12</div><div><div></div><div>80.4 %</div><div>50.0 %</div></div></div><div><div></div><div>testEquivalence_WR13</div><div><div></div><div>76.5 %</div><div>50.0 %</div></div></div><div><div></div><div>testEquivalence_WR2</div><div><div></div><div>78.0 %</div><div>50.0 %</div></div></div><div><div></div><div>testEquivalence_WR3</div><div><div></div><div>75.4 %</div><div>50.0 %</div></div></div><div><div></div><div>testEquivalence_WR4</div><div><div></div><div>74.1 %</div><div>50.0 %</div></div></div><div><div></div><div>testEquivalence_WR5</div><div><div></div><div>72.4 %</div><div>50.0 %</div></div></div><div><div></div><div>testEquivalence_WR6</div><div><div></div><div>79.6 %</div><div>50.0 %</div></div></div><div><div></div><div>testEquivalence_WR7</div><div><div></div><div>76.5 %</div><div>50.0 %</div></div></div><div><div></div><div>testEquivalence_WR8</div><div><div></div><div>76.0 %</div><div>50.0 %</div></div></div><div><div></div><div>testEquivalence_WR9</div><div><div></div><div>76.9 %</div><div>50.0 %</div></div></div></div></div></div>
Strong robust	<div><div><div>1. 延續 weak robust, 將所有區域生成測試資料</div><div>2. 示意圖如下:</div><div><div><div><div><div></div><div>Others</div></div><div><div></div><div>Others</div></div></div><div><div><div></div><div>3月</div></div><div><div></div><div>11月</div></div></div><div><div><div></div><div>Others</div></div><div><div></div><div>1:59:01 ~1:59:59</div></div></div><div><div><div></div><div>2:59:01 ~2:59:59</div></div></div></div></div></div><div><div><div>3. Coverage:</div><div><div><div><div><div></div><div>testEquivalence_SR</div></div><div><div></div><div>73.9 %</div><div>50.0 %</div></div></div><div><div></div><div>main</div><div><div></div><div>0.0 %</div><div>—</div></div></div><div><div></div><div>setUp</div><div><div></div><div>100.0 %</div><div>—</div></div></div><div><div></div><div>suite</div><div><div></div><div>0.0 %</div><div>—</div></div></div><div><div></div><div>tearDown</div><div><div></div><div>100.0 %</div><div>—</div></div></div><div><div></div><div>testEquivalence_SR</div><div><div></div><div>0.0 %</div><div>—</div></div></div><div><div></div><div>testEquivalence_SR1</div><div><div></div><div>85.7 %</div><div>50.0 %</div></div></div><div><div></div><div>testEquivalence_SR10</div><div><div></div><div>76.0 %</div><div>50.0 %</div></div></div><div><div></div><div>testEquivalence_SR11</div><div><div></div><div>80.8 %</div><div>50.0 %</div></div></div><div><div></div><div>testEquivalence_SR12</div><div><div></div><div>80.8 %</div><div>50.0 %</div></div></div><div><div></div><div>testEquivalence_SR13</div><div><div></div><div>76.9 %</div><div>50.0 %</div></div></div><div><div></div><div>testEquivalence_SR14</div><div><div></div><div>74.5 %</div><div>50.0 %</div></div></div><div><div></div><div>testEquivalence_SR15</div><div><div></div><div>72.7 %</div><div>50.0 %</div></div></div><div><div></div><div>testEquivalence_SR16</div><div><div></div><div>73.7 %</div><div>50.0 %</div></div></div><div><div></div><div>testEquivalence_SR17</div><div><div></div><div>73.2 %</div><div>50.0 %</div></div></div><div><div></div><div>testEquivalence_SR18</div><div><div></div><div>73.2 %</div><div>50.0 %</div></div></div><div><div></div><div>testEquivalence_SR19</div><div><div></div><div>71.9 %</div><div>50.0 %</div></div></div><div><div></div><div>testEquivalence_SR2</div><div><div></div><div>78.0 %</div><div>50.0 %</div></div></div><div><div></div><div>testEquivalence_SR20</div><div><div></div><div>71.9 %</div><div>50.0 %</div></div></div><div><div></div><div>testEquivalence_SR21</div><div><div></div><div>72.9 %</div><div>50.0 %</div></div></div><div><div></div><div>testEquivalence_SR22</div><div><div></div><div>72.9 %</div><div>50.0 %</div></div></div><div><div></div><div>testEquivalence_SR23</div><div><div></div><div>73.3 %</div><div>50.0 %</div></div></div><div><div></div><div>testEquivalence_SR24</div><div><div></div><div>80.8 %</div><div>50.0 %</div></div></div><div><div></div><div>testEquivalence_SR25</div><div><div></div><div>76.5 %</div><div>50.0 %</div></div></div><div><div></div><div>testEquivalence_SR3</div><div><div></div><div>75.4 %</div><div>50.0 %</div></div></div><div><div></div><div>testEquivalence_SR4</div><div><div></div><div>72.4 %</div><div>50.0 %</div></div></div><div><div></div><div>testEquivalence_SR5</div><div><div></div><div>72.4 %</div><div>50.0 %</div></div></div><div><div></div><div>testEquivalence_SR6</div><div><div></div><div>73.7 %</div><div>50.0 %</div></div></div><div><div></div><div>testEquivalence_SR7</div><div><div></div><div>73.7 %</div><div>50.0 %</div></div></div><div><div></div><div>testEquivalence_SR8</div><div><div></div><div>79.6 %</div><div>50.0 %</div></div></div><div><div></div><div>testEquivalence_SR9</div><div><div></div><div>80.8 %</div><div>50.0 %</div></div></div></div></div></div></div></div>

C. decision classes

測試目的:

分析各種不同輸入條件的組合對於程式執行結果的影響，找出邏輯中遺漏或相衝突的錯誤。

測試規格:

Conditions::

C1 - end time 在 3 月

C2 - end time 在 11 月

C3 - 3 月的 first Sunday 的通話開始時間小於等於 1:59:59

C4 - 3 月的 first Sunday 的通話結束時間大於等於 1:59:01

C5 - 11 月的 first Sunday 的通話開始時間小於等於 2:59:59

C6 - 11 月的 first Sunday 的通話結束時間大於等於 2:00:00

✓ Actions:

A1 - 通話時間經過日光時間

A2 - 通話時間沒經過日光時間

1. 考慮 6 個 conditions {C1,C2,C3,C4,C5,C6}

2. decision table 作化簡，得出 7 筆 test cases，每筆 case 包含依據不同的 condition 之 assertion 隨機產生出 3 月及 11 月或其他月份的 start date 及 end date，還有通話的 area。

3. Action 判斷是否通過日光節約時間。

4. 以下為 decision table

Condition		1	2	3	4	5	6	7
	C1 . end time 在 3 月	T	T	T	F	F	F	F
	C2 . end time 在 11 月	F	F	F	T	T	T	F
	C3 . 3 月的 first Sunday 的通話開始時間小於等於 1:59:59	T	T	F	-	-	-	-
	C4 . 3 月的 first Sunday 的通話結束時間大於等於 1:59:01	T	F	-	-	-	-	-
	C5 . 11 月的 first Sunday 的通話開始時間小於等於 2:59:59	-	-	-	T	T	F	-
	C6 . 11 月的 first Sunday 的通話結束時間大於等於 2:00:00	-	-	-	T	F	-	-
Action	A1. 通話時間經過日光時間	X			X			
	A2. 通話時間沒經過日光時間		X	X		X	X	X

5. 以下為 coverage

Name	Statement	Branch
Design	84.6 %	68.6 %
Bills	76.9 %	72.1 %
MarchSunday	100.0 %	100.0 %
NovemberSunday	100.0 %	100.0 %
bills	72.2 %	72.2 %
dstMarch	63.6 %	67.9 %
dstNovember	70.0 %	72.7 %
duration	70.0 %	60.0 %
Data	0.0 %	–
decisiontable	87.7 %	50.0 %
decisiontable	0.0 %	–
decisiontable1	95.8 %	50.0 %
decisiontable2	96.0 %	50.0 %
decisiontable3	95.8 %	50.0 %
decisiontable4	95.8 %	50.0 %
decisiontable5	95.8 %	50.0 %
decisiontable6	95.8 %	50.0 %
decisiontable7	92.0 %	50.0 %
main	0.0 %	–
setUp	100.0 %	–
suite	0.0 %	–
tearDown	100.0 %	–

D. Cyclomatic Complexity:

statement and branch coverage : code cover	code cove
Cyclomatic Complexity	McCabe Bills dstMarch 16 bills 14 dstNovember 13 MarchSunday 8 NovemberSunday 8 duration 7