Paper SD-15

Association of Computer Operator Errors and Lunar Phases

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ABTRACT

The frequency of computer operator errors is shown to be related to the phases of the moon. The time of customer contact at a call center is translated into the day of the lunar month. Operator errors in the computer record of each customer contact are matched with the point in time during the lunar cycle. An increase in the frequency of operator errors is measured during Full Moon and New Moon periods.

INTRODUCTION

Anecdotal reports of aberrations in human behavior associated with phases of the moon are well known. Rigorous quantitative measurements of this putative phenomenon are more scarce. In this study, the time of a customer contact at a call center is translated to the day and time of the Lunar Month. Exceptions – errors and inconsistencies in the computer record of a telephone contact – are identified in a daily Exception Report produced by the call center. A total of 946,049 calls from 4/28/2003 through 12/13/2005 are used. The rate of exceptions for an interval near the times of Full and New Moons is compared to the rate at other times.

INTERPOLATION OF LUNAR DAY

When considering the length of the lunar month, the present circumstances require that the length of time from one New Moon to the next be used. This is known as the synodic lunar month. This has a mean value of 29.53 days. (The *sidereal* value – related to sighting the moon in the sky against the background of fixed stars – does not apply to present circumstances.) However, individual lunar months do not have exactly the same length. In order to find the correct day of the month, one needs the exact date and time of the New Moons before and after an event. The New Moon date / time values used here have been provided by a service of the United States Naval Observatory (www.aa.usno.navy.mil/data/docs/RS_OneDay.html).

```
DATA WORK.CONTACTS;
   INFILE 'C:\dcorliss\SAS\MSUG\EXCEPTS.TXT'
           DSD DLM='09'X TRUNCOVER;
   INPUT
      CSC_TIME     :$5.
      CSC_DATE     :8.0
      EXCEPT_FLAG  :$1.
      ;

   EXCEPT = 0;
   IF EXCEPT_FLAG = 'Y' THEN EXCEPT = 1;

   HOURS = SUBSTR(CSC_TIME,1,2);
   MINUTES = SUBSTR(CSC_TIME,4,2);
   TIME = (HOURS + (MINUTES / 60)) / 24;

*** ZONE: UT = CENTRAL STD TIME + 6 HRS ***;

   DATE = CSC_DATE + TIME + (6/24);

   IF DATE < 14645.54 THEN DO;
 NM_BEFORE = 14615.75; NM_AFTER = 14645.54; END;

   ELSE IF DATE < 14675.22 THEN DO;
 NM_BEFORE = 14645.54; NM_AFTER = 14675.22; END;

   ELSE IF DATE < 14704.75 THEN DO;
 NM_BEFORE = 14675.22; NM_AFTER = 14704.75; END;

   ELSE IF DATE < 14734.17 THEN DO;
 NM_BEFORE = 14704.75; NM_AFTER = 14734.17; END;
```

```
  ELSE IF DATE < 14763.50 THEN DO;
NM_BEFORE = 14734.17; NM_AFTER = 14763.50; END;
.
.
.
.
  ELSE IF DATE < 17036.63 THEN DO;
NM_BEFORE = 17007.02; NM_AFTER = 17036.63; END;

  ELSE IF DATE < 17066.32 THEN DO;
NM_BEFORE = 17036.63; NM_AFTER = 17066.32; END;

  ELSE IF DATE < 17096.30 THEN DO;
NM_BEFORE = 17066.32; NM_AFTER = 17096.30; END;

  ELSE IF DATE < 17125.72 THEN DO;
  NM_BEFORE = 17096.30; NM_AFTER = 17125.72; END;

  ELSE IF DATE < 17155.37 THEN DO;
NM_BEFORE = 17125.72; NM_AFTER = 17155.37; END;
```

Once the date and time of the New Moon before and after the date and time of each record is known, the percent of the Lunar month can be interpolated. This percent is translated into days using the mean lunar month.

```
   L_PCT = ROUND(((DATE - NM_BEFORE ) /
               (NM_AFTER - NM_BEFORE)),.01);

   L_DAY = ( (DATE - NM_BEFORE ) /
           (NM_AFTER - NM_BEFORE) ) * 29.53;
```

TIDAL INTERVALS

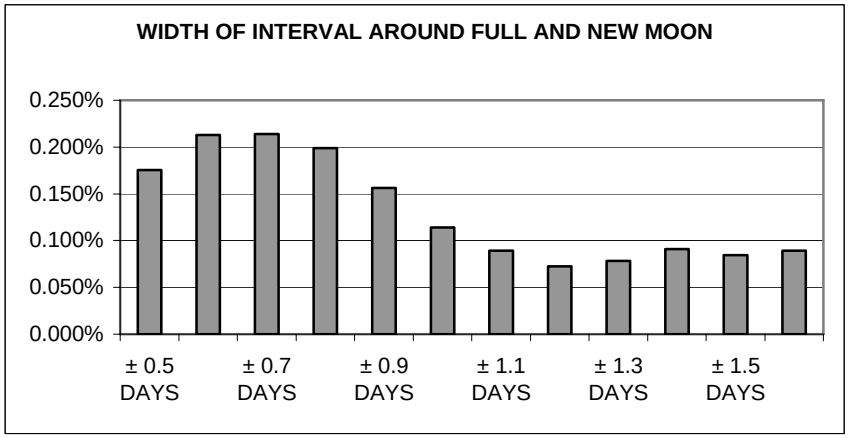
The gravitational forces that create tides vary during the lunar month, reaching maximums at the Full Moon and also the New Moon. A time interval can be identified surrounding the time of these events when tidal effects are the most pronounced. By varying the size of this interval, the period of maximum effect can be identified. The mean exception rate is calculated for the Tidal and Non-Tidal periods.

```
INTERVAL = 0.7;   /* PARAMETER VALUE /*


IF (L_DAY > (29.53 - INTERVAL)) OR
   (L_DAY < INTERVAL)   /* NEW MOON */

OR ((L_DAY > (14.765 - INTERVAL)) AND
   (L_DAY < (14.765 + INTERVAL)))
   /* FULL MOON */

THEN TIDAL = 'Y';

RUN;


PROC SORT DATA=WORK.CONTACTS;
   BY L_PCT;
RUN;

PROC MEANS DATA=WORK.CONTACTS NOPRINT;
   VAR EXCEPT;
   BY L_PCT;
   OUTPUT OUT=WORK.MEANS;
RUN;
```

```
PROC EXPORT DATA=WORK.MEANS
   FILE= 'C:\dcorliss\SAS\MSUG\\L_PCT.xls'
   DBMS=TAB REPLACE;
   WHERE _STAT_ = 'MEAN';
RUN;
```

RESULTS

Figure 1 shows the difference between the exception rates during the Tidal and Non-Tidal periods for different interval durations. A Tidal Interval of ± 0.7 days gives the greatest difference.



For a Tidal Interval of ± 0.7 days, there were 91,082 calls and 1,146 exceptions during the Tidal Periods for a Tidal Exception Rate of 1.258%. There were also 854,967 calls and 8,929 exceptions during the Non-Tidal Periods for a Non-Tidal Exception Rate of 1.044%. The difference between the means of 0.214% is statistically significant with 99% confidence.

REGRESSION MODEL – LEADING SOURCES OF ERROR

A step-wise linear regression model was developed to identify and rank all discernable sources of computer operator error. Fields found to be associated with a statistically significant increase in the rate of errors included error-prone customer service representatives, whether the customer service representative offered to mail literature to the customer ("Group B"), the amount of time since the launch of the program, the number of days since periodic re-assignment of personnel into different teams ("Rotation"), whether the customer contact took place during a Tidal Period and whether the call was taken at a specific call center (a Spanish-Language call center in Costa Rica). Customer Services Representatives found to have an elevated exception rate at 99.9% confidence were identified by a single indicator ERROR_REP. Surprisingly, the number of days since rotation had a positive contribution to the model, indicating that rate of exceptions will increase as the number of days since personnel rotation becomes large. The rate of exceptions was not affected by the day of the week, most types of offers and most Call Center sites. The code used in this regression is below.

```
PROC REG DATA=WORK.CONTACTS;

MODEL EXCEPT = TIDAL EXCEPT_REP PROGRAM_DAY
      ROTATION_DAY GROUP_B NASHVILLE OMAHA
      COSTA_RICA MONDAY_FLAG TUESDAY_FLAG
      WEDNESDAY_FLAG THURSDAY_FLAG
      FRIDAY_FLAG SATURDAY_FLAG /
SELECTION = STEPWISE ALPHA=0.05;

RUN;
```

Here is selected output from the PROC REG:

```
All variables left in the model are significant at the 0.1500 level.

No other variable met the 0.1500 significance level for entry into the model.
```

The REG Procedure Model: MODEL1

Dependent Variable: EXCEPT

Summary of Stepwise Selection

Step	Variable Entered	Partial R-Square	Model R-Square	C(p)
1	EXCEPT_REP	0.0136	0.0136	2971.18
2	PROGRAM_DAY	0.0024	0.0160	631.197
3	GROUP_B	0.0005	0.0165	163.805
4	ROTATION_DAY	0.0001	0.0166	43.6189
5	TIDAL	0.0000	0.0167	8.4201
6	COSTA_RICA	0.0000	0.0167	4.6609

Step	Entered	F Value	Pr > F	Parameter
	INTERCEPT			0.01642
1	EXCEPT_REP	13042.8	<.0001	0.06468
2	PROGRAM_DAY	2340.43	<.0001	-2.032 E-5
3	GROUP_B	469.31	<.0001	0.00514
4	ROTATION_DAY	122.18	<.0001	2.032 E-5
5	TIDAL	37.20	<.0001	0.00216
6	COSTA_RICA	5.76	0.0164	0.00104

CONCLUSION

It can be stated with a very high degree of confidence that the rate of computer operator errors at this call center increases measurably during tidal periods. The interval during which this effect is seen is ± 0.7 days from the time of the New Moon and the Full Moon. This would further indicate that the risk of operators errors associated with new or challenging procedures, such as system launches or revisions, can be reduced by scheduling these events to occur during non-tidal periods.

CONTACT INFORMATION

The author greatly values your thoughts and input.

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