Preference Patterns for Martian Time Architecture

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Abstract

Architecture is about designing space for people to live and work in. Horology and calendrics are about designing time systems for people to live by. They could collectively be called "time architecture." To understand the design implications of the architecture of time requires a working knowledge of astronomy and mathematics, as well as a thorough understanding of how cultures have designed and used time throughout history. Time architecture is at the intersection of the space, the biomedical, and the social sciences.

The Martian Time Survey version 2.x has operated online for just over three years (February 2001 to April 2004) and has accumulated 84 cases. Survey questions are categorized into two classes: questions pertaining to the structure of the Martian clock (number of hours, minutes, and seconds in the day) and calendar (number of days per month, number of months per year, intercalation formulae, et cetera), and questions pertaining to the naming of these Martian units of time. This analysis will focus on response patterns to the structural questions. There are 14 structural questions for which there is adequate data (a 15th question—regarding the placement of the Martian Date Line—was added in February 2004).

This paper builds on previously reported results of the Martian Time Survey version 1.0 (Gangale and Dudley-Rowley 2002) and version 2.x (Gangale and Dudley-Rowley 2003), which discuss in detail the responses to the survey questions.

History of ideas

The first ideas on Martian timekeeping arose 125 years ago as novelists began to speculate on the possibility of a Martian society. The earliest tales envisioned humans encountering indigenous Martian civilizations. Later, as our increasing scientific knowledge of Mars reduced the prospect of advanced forms of Martian life, the trend was toward stories about humans establishing their own cultures on Mars. As incidental minutiae in a fictional narrative, the subject of keeping time on Mars often received superficial treatment, lacking the detail to be a complete and useful system (Heinlein 1949; Clarke 1951; Piper 1957). Occasionally, such ideas were based on a faulty knowledge of astronomy (Burroughs 1913; 1914; Compton 1966; Lovelock and Allaby 1984). Even when complete systems were described that fairly accurately accounted for the orbital factors of Mars, they did not take into account all the timekeeping needs of a human society (Greg 1880).

The first complete Martian calendar was developed by an astronomer who was active in the calendar reform movement in the 1930s (Aitken 1936; 1936a). Another astronomer invented a complete timekeeping system in the 1950s, going so far as to have a functioning Earth-Mars clock-calendar constructed (Levitt 1954; 1955; 1956). Not only did these systems accurately reflect the astronomical cycles of Mars, but they also took into account many of the sociological aspects of timekeeping.

More ideas on Martian timekeeping have been generated as interest in sending humans to Mars has increased. The Case for Mars series of conferences included two presentations on Martian time (Mackenzie 1989; Gangale, 1997). In the 1990s, roughly 20 authors wrote on the subject.

The first commercially printed Martian calendar was available for the Martian year bracketing the turn of the millennium on Earth (Graham and Elliott 1998; 1999). A number of real-time Martian clocks are currently posted on the World Wide Web. Links to more than a hundred online Martian timekeeping topics are available on the Martian Time website at http://www.martiana.org/mars/. Among the most widely-published conceptualizations of Martian time architecture are the following:

1. I published the first article on the Darian calendar in 1986. Since then it has attracted a number of adherents (Knapp 1997; Blok 1999; Hensel 1999) and imitators (Moss 1999; Moss et al. 2001; Heron 2001; Naughton and O'Meara 2001). It is cited on the Web (Wikipedia 2003) and in print (Sakers 2004), and may be featured in a science fiction novel currently in work (Needles 2004). Similar systems were proposed independently of my work during the period of Mars enthusiasm occasioned by the *Mars Pathfinder/Sojourner* mission (Schmidt 1997; Serra Martín 1997; Sherwood 1997; Šurán, 1997; Woods 1997; Hollon 1998).

2. The science fiction author Kim Stanley Robinson described both a Martian clock and a Martian calendar in his 1993 novel, *Red Mars,* the first in a trilogy of Martian novels that are probably the most widely read of that genre to ever be published. His calendar is similar to the Darian calendar in a number of respects; however, there are also important distinctions.

3. Robert Zubrin published his ideas for a Martian calendar in the November/December 1993 issue of *Ad Astra,* the National Space Society's magazine. He also described his

calendar in his 1996 book, *The Case for Mars*. Due to his position as president of the Mars Society, Zubrin's calendar proposal continues to attract the interest of the Mars enthusiast community.

Research Questions, Hypotheses, and Tests

The 14 survey questions all yield categorical data. The research questions I will explore are whether there are distinct sets of response patterns in the data that can be characterized as measurement variables. I hope to be able to identify the following response groups:

1. Darians—responses that are most aligned with my articles on Martian timekeeping (Gangale 1986; 1999).

2. Robinsonians—responses that are most aligned with science fiction author Kim Stanley Robinson's ideas on Martian timekeeping (Robinson 1993).

3. Zubrinistas—responses that are most aligned with Mars Society president Robert Zubrin's ideas on Martian timekeeping (Zubrin 1993; Zubrin and Wagner 1996).

4. Decimalists—responses that reflect a preference for organizing Martian time on the basis of powers of 10.

5. Byters—responses that reflect a preference for organizing Martian time on the basis of 8, 16, or 32.

Completeness of response will be an independent variable. The response patterns of the hypothesized groups will be measured as dependent variables for their completeness. It may be possible to draw conclusions regarding how well-formed opinions are in these groups.

Clock designs and calendar designs are self-contained systems, independent of each other. However, in addition to discussing our calendar designs, Robinson, Zubrin, and I each describe our preferred clock system. Thus the relationship (or lack thereof) in the response data between the preferred clock and the preferred calendar design details can be explored. For this reason, only survey questions pertaining the calendar design choices will be use to define the hypothesized response groups.

Several tests were performed on the data:

1. Test for normality of the distribution in the hypothesized response groups.
2. Test for probability that the hypothesized response groups are not distinct groups.
3. Test for probability that support for the 7-day week is independent of support for the 28-day month.

Methods of Analysis

Methods include univariate analysis of the hypothesized response group variables and the Completeness variables. Bivariate analysis includes (see Table 1):

1. Hypothesized response groups versus completeness of response (Scatterplots and simple regression).

2. Selected pairs of survey questions (Chi-Square).

3. Hypothesized response groups versus preference for the 24:60:60 stretched clock, 24:60:60 + 00:39:35.2 time-slip clock, decimal/semi-decimal clocks, and octal/hexadecimal clocks (Chi-Square).

Table 1: Methods of Analysis

		Independent Variable	
		Categorical Variable	**Continuous Variable**
Dependent Variable	**Categorical Variable**	14 structural survey questions Clock vs. summed indices: Darians Robinsonians Zubrinistas (Chi-Square)	
	Continuous Variable	Indices: Darians Robinsonians Zubrinistas (ANOVA)	Completeness v.: Darians Robinsonians Zubrinistas (Simple Regression & Scatterplots)

Survey Questions

The 14 survey questions on the structure of Martian timekeeping systems, together with the response options for each, are listed in the Appendix.

Derived Measurement Variables

The 14 survey questions yielded categorical data. Measurement variables were derived from the responses to the survey questions pertaining to calendar design factors:

1. Darian index—a measure of the degree to which a respondent's answers correlated to design features of the Darian calendar.

2. Robinsonian index—a measure of the degree to which a respondent's answers correlated to design features of the Robinson calendar.

3. Zubrinista index—a measure of the degree to which a respondent's answers correlated to design features of the Zubrin calendar.

4. Decimalist index—a measure of the degree to which a respondent's answers correlated to design features of a calendar based on divisions or multiples of 10.

5. Byter index—a measure of the degree to which a respondent's answers correlated to design features of a calendar based on divisions or multiples 8, 16, or 32.

6. Completeness index—a measure of the completeness of a respondent's answers.

The Darian index was constructed from the following responses to twelve survey questions:

Table 2: Criteria for Constructing the Darian Index (DarianCd)

Variable	Value(s)	Meaning
Week1-1	7	7-day week
Month1-1	28	24 28-day months of approximately equal duration
Year1-1	1	1 leap day in a leap year
Year1-2	110	Basic intercalation algorithm: odd years + decennial years
Year1-3	7	Leap year position: end of the year
Year1-4	 2 3 4	Cycle for synchronizing the days of the week: 1 month 1 year 2 years
Year1-5	1 6	Add a day that does not fall within the weekly scheme (a holiday) in leap years Shorten the week by one day, three to four times per year
Epoch1-1	1	When to begin using the calendar: now
Epoch1-2	4	Cycle for incrementing the year count: Martian year
Epoch1-3	 1609 1976	Earth year for starting year count: 1609 1976
Epoch1-4	10	Solar longitude for beginning calendar year: vernal equinox
Epoch1-5	0	Integer for beginning year count: 0

Each response complying with the above rules was coded as “1.” The total score for each respondent was then divided by 12 to yield a score on a scale of 0 to 1. Cases scoring 0 were nulled.

The Robinsonian index was constructed from the following responses to nine survey questions:

Table 3: Criteria for Constructing the Robinsonian Index (RobinCd)

Variable	Value(s)	Meaning
Week1-1	7	7-day week
Month1-1	28	24 28-day months of approximately equal duration
Year1-1	1	1 leap day in a leap year
Year1-4	1	Cycle for synchronizing the days of the week: none
Epoch1-1	2	When to begin using the calendar: first human landing on Mars
Epoch1-2	4	Cycle for incrementing the year count: Martian year
Epoch1-3	5	Earth year for starting year count: first human landing on Mars
Epoch1-4	10	Solar longitude for beginning calendar year: vernal equinox
Epoch1-5	1	Integer for beginning year count: 1

Each response complying with the above rules was coded as "1." The total score for each respondent was then divided by 9 to yield a score on a scale of 0 to 1. Cases scoring 0 were nulled.

The Zubrinista index was constructed from the following responses to eight survey questions:

Table 4: Criteria for Constructing the Zubrinista Index (ZubrinCd)

Variable	Value(s)	Meaning
Month1-1	4666	12 months varying in duration from 46 to 66 days
Year1-1	1	1 leap day in a leap year
Year1-4	1	Cycle for synchronizing the days of the week: none
Epoch1-1	1	When to begin using the calendar: now
Epoch1-2	4	Cycle for incrementing the year count: Martian year
Epoch1-3	1961	Earth year for starting year count: 1961
Epoch1-4	10	Solar longitude for beginning calendar year: vernal equinox
Epoch1-5	1	Integer for beginning year count: 1

Each response complying with the above rules was coded as "1." The total score for each respondent was then divided by 8 to yield a score on a scale of 0 to 1. Cases scoring 0 were nulled.

The Decimalist index was constructed from the following responses to three survey questions:

Table 5: Criteria for Constructing the Decimalist Index (DecCd)

Variable	Value(s)	Meaning
Week1-1	10	10-day week
Month1-1	67	10 67-day months of approximately equal duration
Year1-1	10	10 leap days in a leap year

Each response complying with the above rules was coded as "1." The total score for each respondent was then divided by 3 to yield a score on a scale of 0 to 1. However, the three criteria available for constructing this index resulted in a much less continuous variable that more resembled ordinal data than measurement data. Also, the number of nonzero Decimalist cases was only 11. On the basis of these considerations, no further analysis was done on the calendar Decimalists. However, useful data was obtained on clock Decimalists (see the discussion on construction of the "Clock" variable).

The Byter index was constructed from the following responses to two survey questions:

Table 6: Criteria for Constructing the Byter Index (ByteCd)

Variable	Value(s)	Meaning
Week1-1	8	8-day week
Month1-1	32	21 32-day months of approximately equal duration

Each response complying with the above rules was coded as "1." The total score for each respondent was then divided by 3 to yield a score on a scale of 0 to 1. However, the two criteria available for constructing this index resulted in a much less continuous variable that more resembled ordinal data than measurement data. Also, the number of nonzero Byter cases was only 3. On the basis of these considerations, no further analysis was done on the calendar Byters. However, useful data was obtained on clock Byters (see the discussion on construction of the "Clock" variable).

The Completeness index "Comp2" was constructed from all 14 survey questions. Blank or "no opinion" responses were coded as null; all others were coded as "1." Additionally, the Completeness score was nulled in cases for which the Darian, Robinsonian, and Zubrinista scores were all null.

Derived Categorical Variable

A new categorical variable "Clock" was derived from the "Day1-2" survey question.

Table 7: Criteria for Constructing the "Clock" Variable

Clock Value	Day1-2 Value(s)	Meaning
0	240	24:60:60 stretched clock
1	32	24:60:60 + 00:39:35 time-slip clock
2	 10 11 100	Decimal or semi-decimal clock: 10:100:100 20:50:100 1000:1000
3	 8 16	Octal or hexadecimal clock 8:8:8:8:8:8 16:16:16:16
4	All other responses except "No opinion"	Other clocks

A tabulation of the "Clock" variable is provided in Table 8. The stretched clock enjoyed the support of 35.6% of the respondents. Support for the time-slip clock was less than half this figure at 17.0%, as was support for some flavor of decimal or semi-decimal clock. Support for a clock based on some multiple of 8 was half again at 8.5%. Other responses not including "No opinion" accounted for an additional 22.0%.

Table 8: Tabulation of the "Clock" Variable

. tabulate Clock

Clock	Freq.	Percent	Cum.
0	21	35.59	35.59
1	10	16.95	52.54
2	10	16.95	69.49
3	5	8.47	77.97
4	13	22.03	100.00
Total	59	100.00	

Univariate Analysis of Calendar Preferences

At the outset, it should be noted that the Martian Time Survey is not a random sample. Respondents are entirely self-selected. In view of this, the question of whether the derived variables are normally distributed needs to be explored before proceeding further. Table 9 gives a summary of means and standard deviations for the derived measurement variables.

Table 9: Summary of Means and Standard Deviations

Variable	Obs	Mean	Std. Dev.	Min	Max
DarianCd	66	.48	.2289777	.08	.92
RobinCd	65	.4286154	.1820189	.11	.78
ZubrinCd	61	.3655738	.1775624	0	.75
Comp2	66	.7642424	.2196645	.07	1

Several observations can be made from the summary statistics in Table 9. First of all, the ranking of the number of observations for the Darians, Robinsonians, and Zubrinistas is the reverse order of the number of survey questions used to define each group. This makes intuitive sense; the more questions included in the construction of the index, the more likely there is a non-null response to at least one of those questions. On the other hand, the ranking of the standard deviations for these variables is the same order as the number of observations for the variables (and the reverse order of the number of survey questions used to define each group). While this is counter to the Central Limit Theorem, according to which variance should decrease with increasing number of observations, all other things being equal, and assuming normal distribution, in this case the difference in the number of observations is not large enough to expect this behavior.

A second observation is that although the Darian, Robinsonian, and Zubrinista indices were all calculated on a scale from 0 to 1, the means differ, with the Darians scoring highest on their scale and the Zubrinistas scoring lowest on their scale.

The distribution of the Darian index is slightly positively skewed (0.10), with a mean of 0.480 and a median of 0.50 (see Table 10 and Figure 1). (Ordinarily this difference in mean and median would indicate a slightly negative skew, but is misleading in this case due to the fact that the values of the observations are limited to 12 quantities). Note that the number of bins (11) in the histogram is one less than the number of survey questions used to construct the Darian index. The distribution is approximately normal, although it also contains two weak modes (8 observations, or 12.1% of the 66 total observations, each at values of 0.17 and 0.42), and has a low Kurtosis value (1.93). The range is from 0.08 to 0.92 (a difference of 0.88), and the interquartile range is from 0.25 to 0.67 (a difference of 0.42). There are no outliers (see Figure 2). According to the Shapiro-Wilk W test for normality, the probability that the Darian population is normally distributed is 0.23, and according to the Shapiro-Francia W' test, the probability is 0.41 (see Table 11).

Table 10: Summary Statistics for the Darian Index

DarianCd				
	Percentiles	Smallest		
1%	.08	.08		
5%	.17	.08		
10%	.17	.17	Obs	66
25%	.25	.17	Sum of Wgt.	66
50%	.5		Mean	.48
		Largest	Std. Dev.	.2289777
75%	.67	.83		
90%	.83	.83	Variance	.0524308
95%	.83	.92	Skewness	.1046717
99%	.92	.92	Kurtosis	1.932194

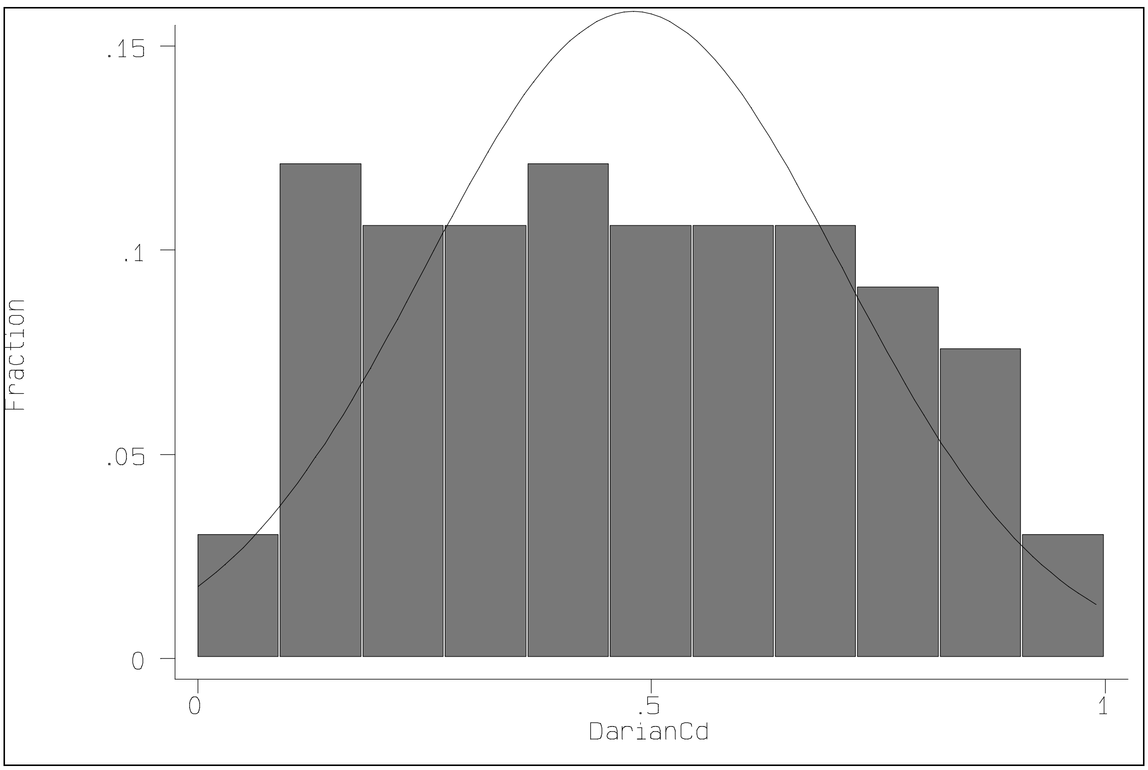

Figure 1: Histogram of the Darian Index

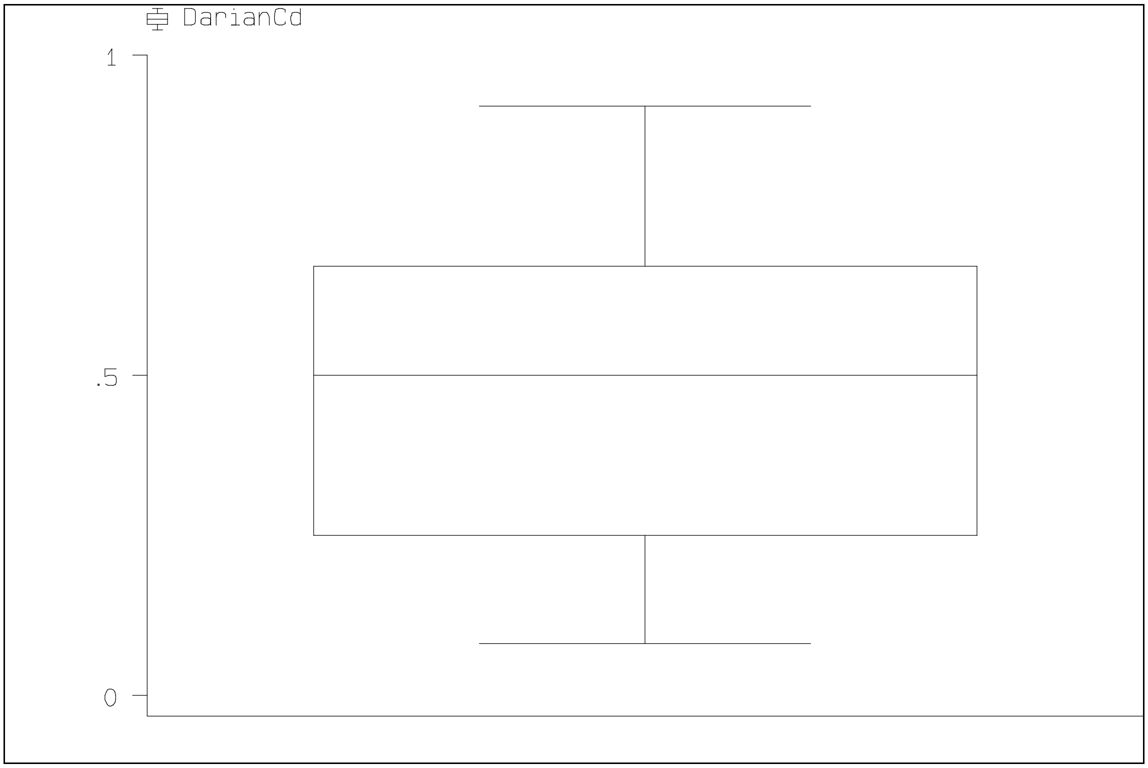

Figure 2: Boxplot of the Darian Index

Table 11: Normality Test for the Darian Index

```
. swilk  DarianCd

                  Shapiro-Wilk W test for normal data
 Variable |    Obs          W          V          z   Pr > z
 ---------+-------------------------------------------------
 DarianCd |     66     0.97617     1.399      0.727  0.23361

. sfrancia  DarianCd

              Shapiro-Francia W' test for normal data
 Variable |    Obs          W'         V'         z    Pr>z
 ---------+-------------------------------------------------
 DarianCd |     66     0.98253     1.128      0.238  0.40575
```

The distribution of the Robinsonian index is slightly negatively skewed (-0.12), with a mean of 0.424 and a median of 0.44 (see Table 12 and Figure 3). Note that the number of bins (8) in the histogram is one less than the number of survey questions used to construct the Robinsonian index. The distribution is normal and has a low Kurtosis value (2.23). The range is from 0.11 to

0.78 (a difference of 0.67), and the interquartile range is from 0.33 to 0.56 (a difference of 0.23). There are no outliers (see Figure 4). According to the Shapiro-Wilk W test for normality, the probability that the Robinsonian population is normally distributed is 0.81, and according to the Shapiro-Francia W' test, the probability is 0.99 (see Table 13).

Table 12: Summary Statistics for the Robinsonian Index

```
                            RobinCd
-------------------------------------------------------------
      Percentiles      Smallest
 1%          .11            .11
 5%          .11            .11
10%          .11            .11       Obs                  66
25%          .33            .11       Sum of Wgt.          66

50%          .44                      Mean           .4237879
                        Largest       Std. Dev.      .1848223
75%          .56            .67
90%          .67            .78       Variance       .0341593
95%          .67            .78       Skewness      -.1223816
99%          .78            .78       Kurtosis        2.22691
```

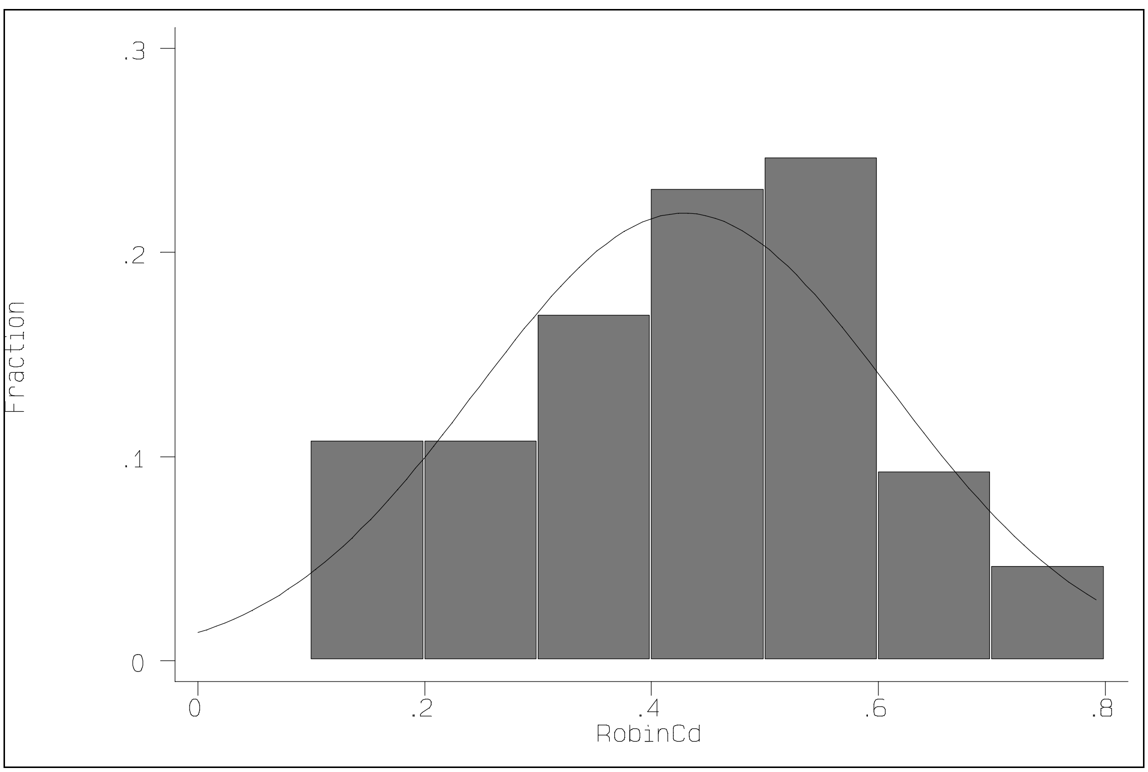

Figure 3: Histogram of the Robinsonian Index

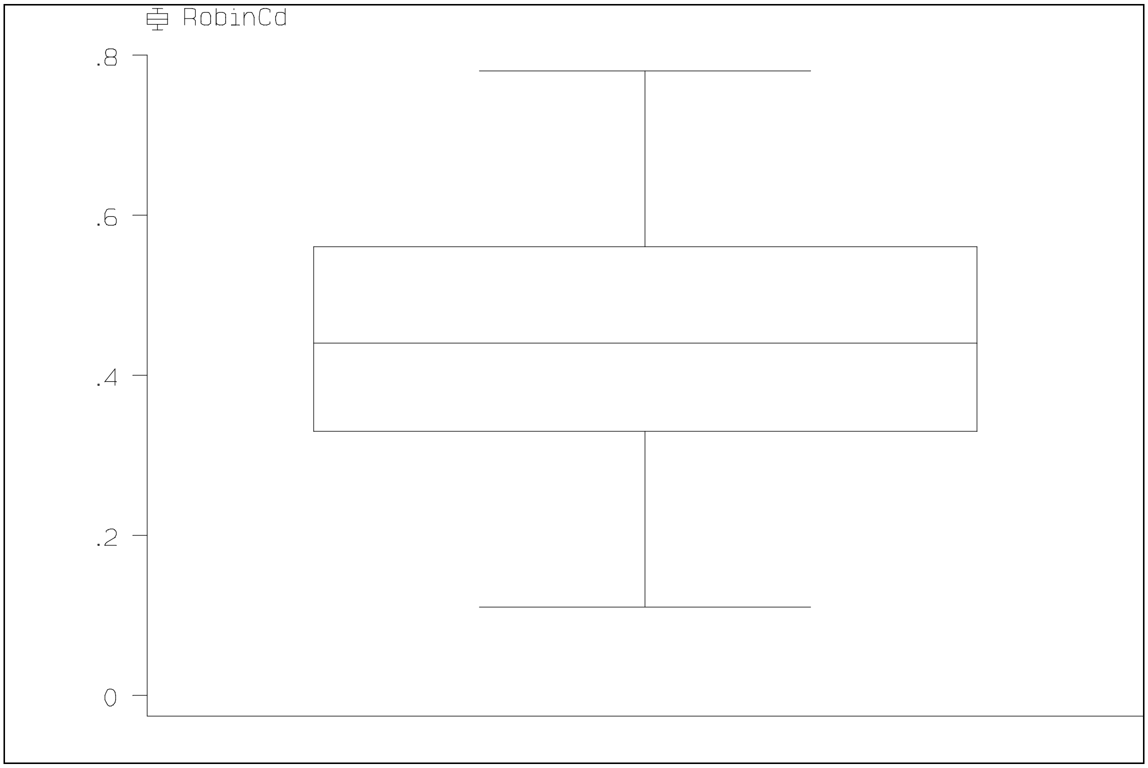

Figure 4: Boxplot of the Robinsonian Index

Table 13: Normality Test for the Robinsonian Index

```
. swilk  RobinCd

                   Shapiro-Wilk W test for normal data
 Variable |    Obs         W          V          z   Pr > z
---------+-----------------------------------------------------
  RobinCd |     65     0.98852     0.665     -0.882  0.81106

. sfrancia  RobinCd

               Shapiro-Francia W' test for normal data
 Variable |    Obs         W'        V'          z    Pr>z
---------+-----------------------------------------------------
  RobinCd |     65     0.99543     0.291     -2.537  0.99441
```

The distribution of the Zubrinista index is slightly positively skewed (0.18), with a mean of 0.378 and a median of 0.38 (see Table 14 and Figure 5). (Ordinarily this difference in mean and median would indicate a slightly negative skew, but is misleading in this case due to the fact that the values of the observations are limited to 8 quantities). Note that the number of bins (7) in the histogram is one less than the number of survey questions used to construct the Zubrinista index. The distribution is normal and has a low Kurtosis value (2.39) despite the very pronounced mode of 19 observations (32.2% of the 59 total observations) with values of 0.38. The range is from 0.13 to 0.75 (a difference of 0.62), and the interquartile range is from 0.25 to 0.50 (a difference of 0.25). There are no outliers (see Figure 6). According to the Shapiro-Wilk W test for normality, the probability that the Zubrinista population is normally distributed is 0.29, and according to the Shapiro-Francia W' test, the probability is 1.00 (see Table 15).

Table 14: Summary Statistics for the Zubrinista Index

```
                          ZubrinCd
-------------------------------------------------------------
      Percentiles      Smallest
 1%          .13            .13
 5%          .13            .13
10%          .13            .13       Obs                  59
25%          .25            .13       Sum of Wgt.          59

50%          .38                      Mean           .3779661
                        Largest       Std. Dev.      .1668861
75%           .5            .63
90%          .63            .63       Variance        .027851
95%          .63            .75       Skewness       .1774462
99%          .75            .75       Kurtosis       2.389358
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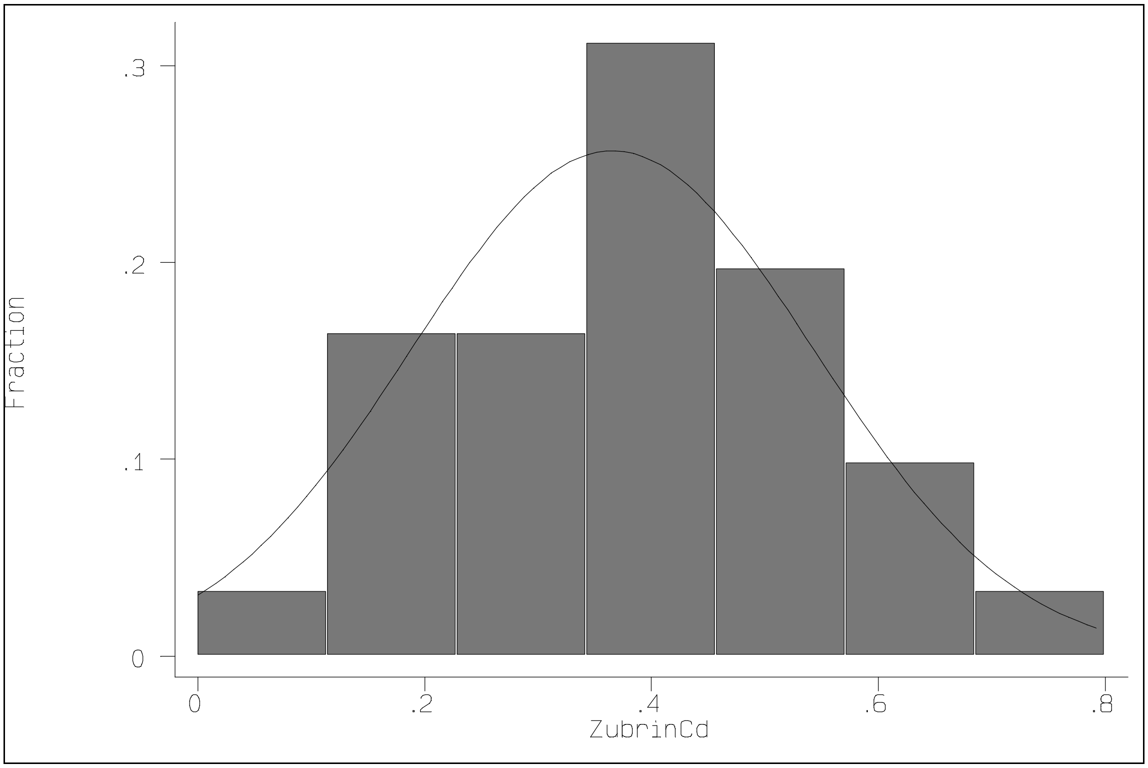

Figure 5: Histogram of the Zubrinista Index

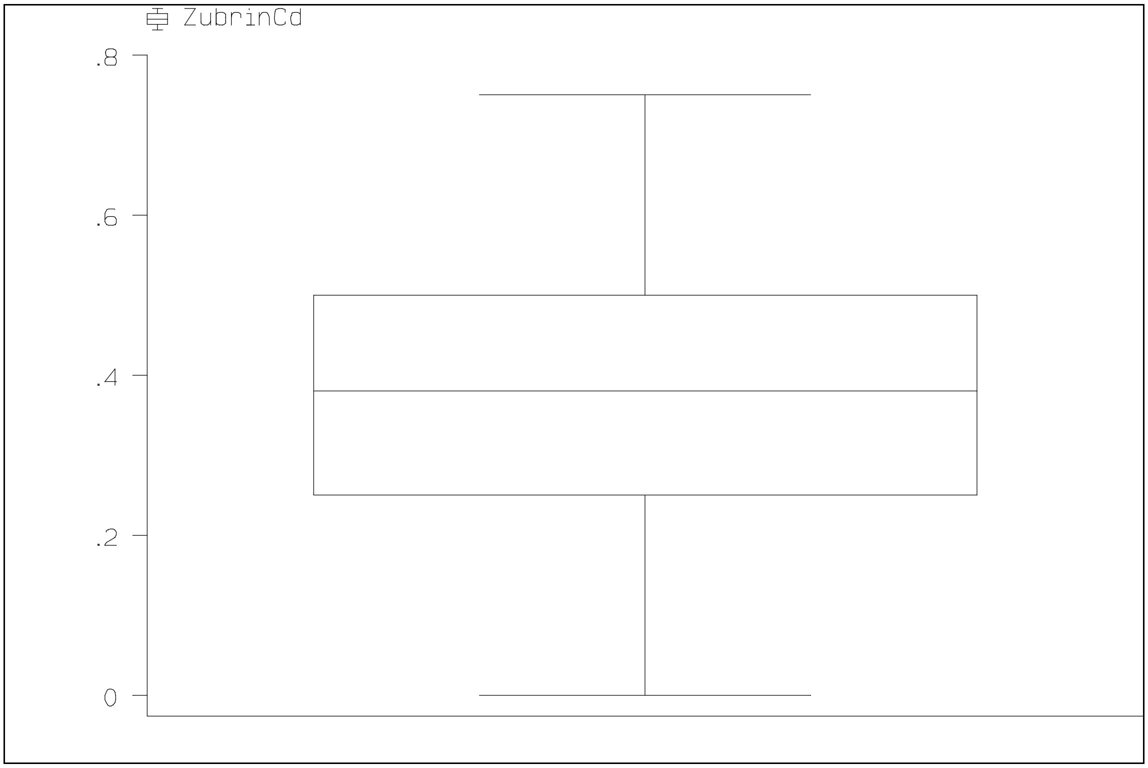

Figure 6: Boxplot of the Zubrinista Index

Table 15: Normality Test for the Zubrinista Index

```
. swilk  ZubrinCd

                  Shapiro-Wilk W test for normal data
 Variable |    Obs          W          V          z   Pr > z
 ---------+-------------------------------------------------
 ZubrinCd |     59    0.97586     1.294      0.556  0.28921

. sfrancia  ZubrinCd

              Shapiro-Francia W' test for normal data
 Variable |    Obs         W'         V'          z    Pr>z
 ---------+-------------------------------------------------
 ZubrinCd |     59    0.99917     0.049     -6.482  1.00000
```

The distribution of the Completeness index is highly negatively skewed (-1.49), with a mean of 0.764 and a median of 0.825 (see Table 14 and Figure 5). Note that the number of bins (13) in the histogram is one less than the number of survey questions used to construct the Completeness index. The distribution is normal and has a high Kurtosis value (4.74), with a very pronounced mode of 20 observations (30.3% of the 66 total observations) with values of 0.93. The range is from 0.07 to 1.00 (a difference of 0.93), and the interquartile range is from 0.71 to 0.93 (a difference of 0.22). There are six low outliers: two observations at a value of 0.07, one at 0.21, and three at 0.36 (see Figure 6). According to the Shapiro-Wilk W test for normality, the probability that the Completeness population is normally distributed is less than 0.000005, and according to the Shapiro-Francia W' test, the probability is 0.00002 (see Table 15). The non-normal, highly negative skew is not a conceptual problem, however. One would expect respondents to generally endeavor to be complete in their responses, especially given that they are self-selected rather than randomly-selected.

Table 16: Summary Statistics for the Completeness Index

```
                            Comp2
-------------------------------------------------------------
      Percentiles      Smallest
 1%          .07            .07
 5%          .36            .07
10%          .43            .21       Obs                  66
25%          .71            .36       Sum of Wgt.          66

50%         .825                      Mean           .7642424
                        Largest       Std. Dev.      .2196645
75%          .93              1
90%          .93              1       Variance       .0482525
95%            1              1       Skewness      -1.492667
99%            1              1       Kurtosis       4.735652
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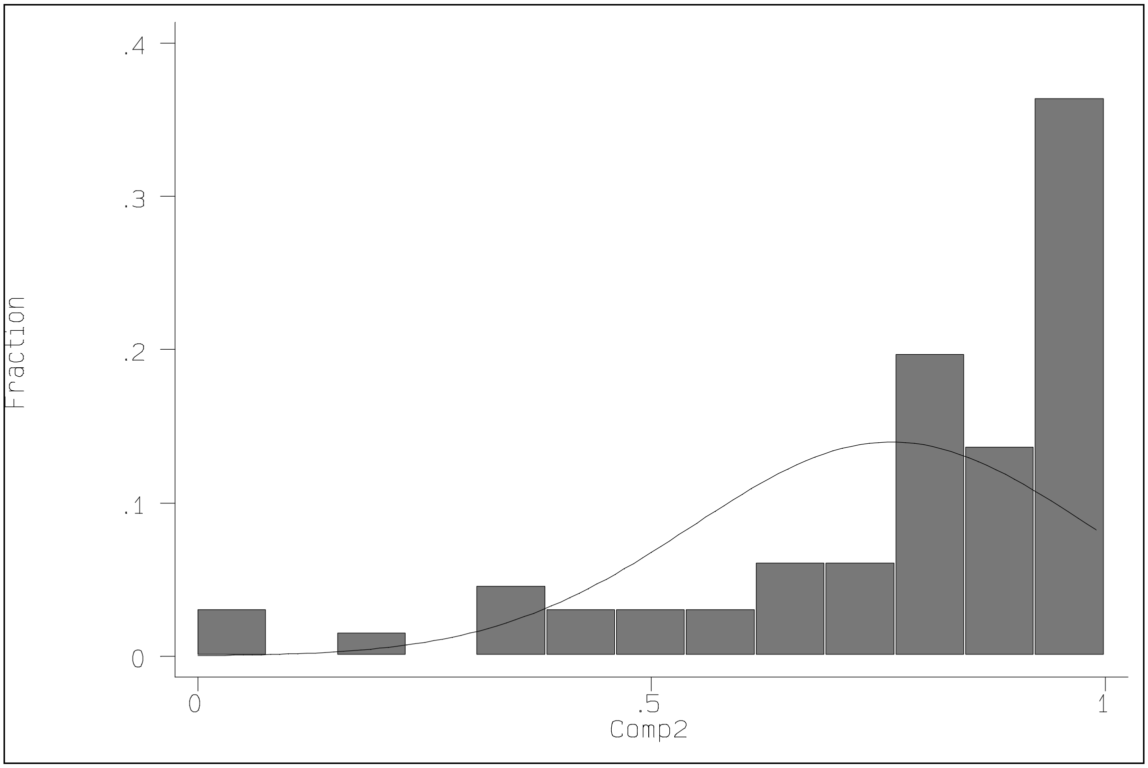

Figure 7: Histogram of the Completeness Index

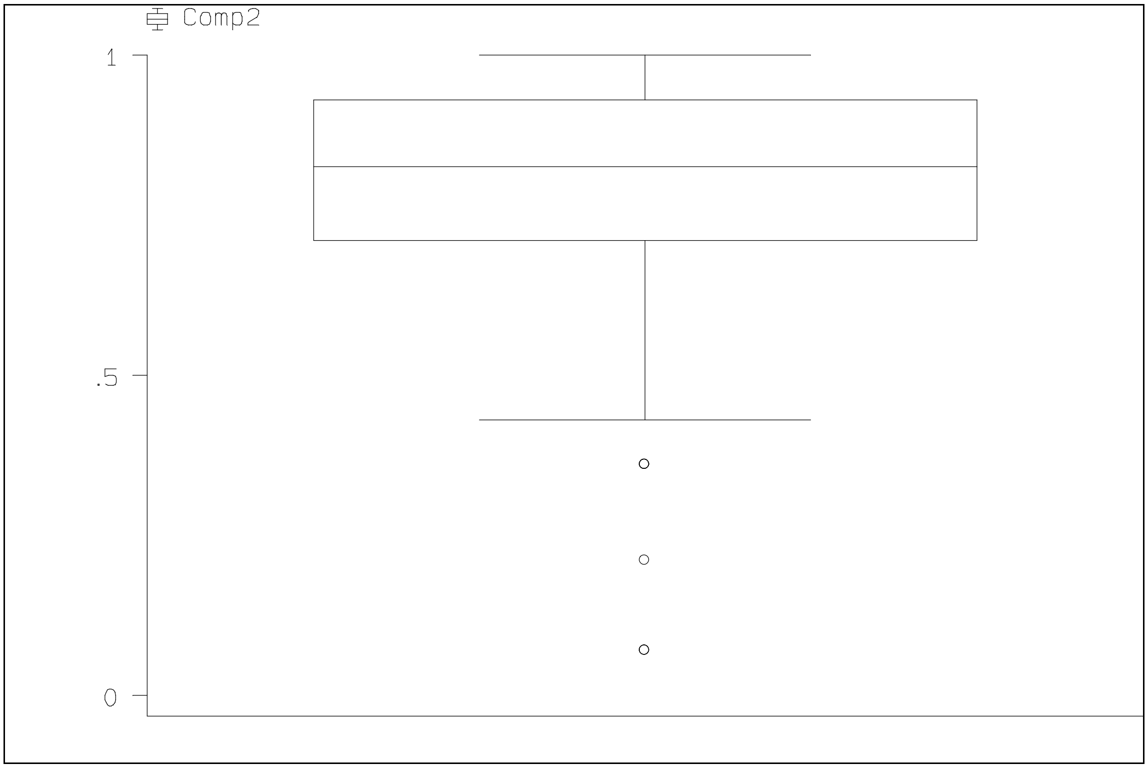

Figure 8: Boxplot of the Completeness Index

Table 17: Normality Test for the Completeness Index

```
. swilk  Comp2

                   Shapiro-Wilk W test for normal data
 Variable |    Obs          W          V          z   Pr > z
 ---------+-------------------------------------------------
    Comp2 |     66    0.84642      9.013      4.765  0.00000

. sfrancia  Comp2

               Shapiro-Francia W' test for normal data
 Variable |    Obs          W'         V'         z    Pr>z
 ---------+-------------------------------------------------
    Comp2 |     66    0.86364      8.805      4.062  0.00002
```

Figure 9 provides a side-by-side comparison of the boxplots for the Darian, Robinsonian, Zubrinista, and Completeness indices. As noted earlier in discussing the differences in the means of the Darians, Robinsonians, and Zubrinistas, so it is with the differences of the medians since these samples are only slightly skewed, in that the Darians are more Darian than the

Zubrinistas are Zubrinist. This is a rather surprising result, for given that Zubrin is the president of the Mars Society, the author of several books, and very much a public figure, one might surmise that his Martian calendar design would command a more cohesive and more supportive response than would the Darian calendar. For the same reason, it is also surprising that the Darians are more Darian than the Robinsonians are Robinsonian, given that Robinson's three Martian novels are probably the most widely read of that genre to ever be published.

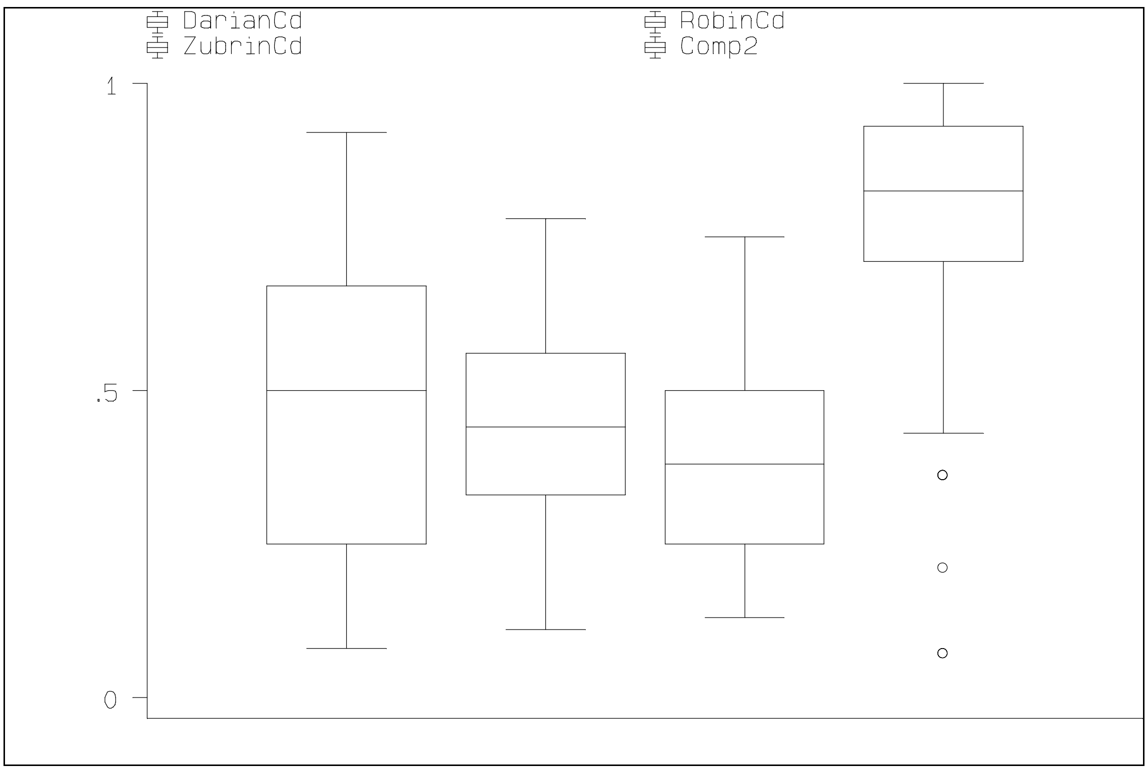

Figure 9: Boxplots of the Darian, Robinsonian, Zubrinista, and Completeness Indices

However, is this difference in the means of the three response groups statistically significant? Table 18 provides summary statistics for the three indices.

Table 18: Summary Statistics for the Darian, Robinsonian, and Zubrinista Indices

Index	Mean	Std Dev	Median	Frequency
Darians	0.48	0.228978	0.50	66
Robinsonians	0.42378790	0.184822	0.44	66
Zubrinistas	0.3779661	0.166886	0.38	59
All	0.42989766	0.198616	0.42	191

Table 19 gives a one-way analysis of variance for the three groups. The null hypothesis is that the difference in the means between the three response groups is not significant.

Table 19: One-Way ANOVA for the Darian, Robinsonian, and Zubrinista Indices

	Sum of Squares	df	Mean of Squares	*F*	Prob>*F*
Between Groups	0.00524446	2	0.002622230	0.069302	>>0.25
Within Groups	7.11354356	188	0.037837998		
Total	7.45574338	190	0.037467305		

The critical value of F for statistical significance with 2 and 188 degrees of freedom at $P = 0.05$ is 3.00; however, the sample F value is 0.07:

$$P(F[2,188] > 0.07) >> 0.25$$

The null hypothesis cannot therefore be rejected. The research hypothesis, that the difference in the means between the three groups is statistically significant, is not supported.

Relationships Between Calendar Response Indices

Paired difference *t*-tests were run on the Darian vs. Robinsonian indices, Darians vs. Zubrinistas, and Robinsonian vs. Zubrinistas, to determine the probability of a relation between any pair of indices (see Table 20 through Table 22). These tests were of particular interest in the case of the Darian-Robinsonian pair, since these two calendars share five design features (see Table 23). The null hypothesis is that there is no relationship between any pair of indices. The difference *t*-tests show that the Darians and Zubrinistas are least alike, with the probability of zero mean difference in paired data is less than 0.00005. Between Robinsonians and Zubrinistas, probability of zero mean difference in paired data is 0.0003. Unsurprisingly, the probability of zero mean difference in Darian-Robinsonian paired data is greatest at 0.0060, but is still well below the level where we would reject the null hypothesis.

Table 20: Paired Difference *t*-Test, Darians and Robinsonians

```
. ttest DarianCd = RobinCd

  Variable |      Obs        Mean   Std. Dev.
  ---------+---------------------------------
  DarianCd |       65    .4847692     .227432
   RobinCd |       65    .4286154    .1820189
  ---------+---------------------------------
     diff. |       65    .0561538    .1591353

             Ho:  mean difference = 0  (paired data)
                  t = 2.84 with 64 d.f.
              Pr > |t| = 0.0060
 95% CI for difference = (.01672184,.09558584)
```

Table 21: Paired Difference *t*-Test, Darians and Zubrinistas

```
. ttest DarianCd = ZubrinCd

  Variable |      Obs        Mean   Std. Dev.
  ---------+---------------------------------
  DarianCd |       61    .5029508    .2216705
  ZubrinCd |       61    .3655738    .1775624
  ---------+---------------------------------
     diff. |       61    .1373771    .2015432

             Ho:  mean difference = 0  (paired data)
                  t = 5.32 with 60 d.f.
              Pr > |t| = 0.0000
 95% CI for difference = (.08575905,.18899505)
```

Table 22: Paired Difference *t*-Test, Robinsonians and Zubrinistas

```
. ttest RobinCd = ZubrinCd

  Variable |      Obs        Mean   Std. Dev.
  ---------+--------------------------------
   RobinCd |       60       .4515    .1684005
  ZubrinCd |       60       .3695    .1763704
  ---------+--------------------------------
     diff. |       60        .082    .1654762

             Ho:  mean difference = 0  (paired data)
                     t = 3.84 with 59 d.f.
              Pr > |t| = 0.0003
 95% CI for difference = (.039253,.124747)
```

Table 23: Common Design Features of the Darian and Robinson Calendars

Variable	Value(s)	Meaning
Week1-1	7	7-day week
Month1-1	28	24 28-day months of approximately equal duration
Year1-1	1	1 leap day in a leap year
Epoch1-2	4	Cycle for incrementing the year count: Martian year
Epoch1-4	10	Solar longitude for beginning calendar year: vernal equinox

Response Completeness of Among Calendar Response Indices

A regression analysis of each response group on the Completeness index was performed. Completeness of response was used as the independent variable, with the response patterns of the groups measured as dependent variables for their completeness. The positive correlation between the fidelity of the group's response to the design details of the particular calendar and the completeness of response is strongest in the Darian group, which has a slope of 0.72 (see Table 24). The weakest correlation is in the Robinsonian group, which has a slope of 0.59 (see Table 25). The regression slope of the Zubrinista group versus the Completeness index is 0.64 (see Table 26). However, the slopes are not the whole story. The *y*-intercepts also have meaning, for taken together with their respective slopes, they determine the overall level of completeness of response in each group. Figure 10 shows both the slopes and the relative levels of the regression lines of the three groups. Generally speaking, the Darians and Robinsonians are more complete in their responses than the Zubrinistas, and except for the few responses at the low end, the Darians are slightly more complete in their responses than the Robinsonians.

Table 24: Regression of Darian Index on Completeness Index

Source	SS	df	MS
Model	1.62013711	1	1.62013711
Residual	1.78786286	64	.027935357
Total	3.40799997	65	.052430769

Number of obs =	66
F(1, 64) =	58.00
Prob > F =	0.0000
R-squared =	0.4754
Adj R-squared =	0.4672
Root MSE =	.16714

DarianCd	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Comp2	.7187193	.0943758	7.616	0.000	.530182	.9072566
_cons	-.0692758	.0750028	-0.924	0.359	-.2191111	.0805595

Table 25: Regression of Robinsonan Index on Completeness Index

Source	SS	df	MS
Model	1.10796719	1	1.10796719
Residual	1.01240817	63	.016069971
Total	2.12037536	64	.033130865

Number of obs =	65
F(1, 63) =	68.95
Prob > F =	0.0000
R-squared =	0.5225
Adj R-squared =	0.5150
Root MSE =	.12677

RobinCd	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Comp2	.5944202	.0715876	8.303	0.000	.4513638	.7374765
_cons	-.0254302	.0568976	-0.447	0.656	-.139131	.0882707

Table 26: Regression of Zubrinista Index on Completeness Index

Source	SS	df	MS
Model	.555814911	1	.555814911
Residual	1.05954103	57	.018588439
Total	1.61535594	58	.027850965

Number of obs	= 59
F(1, 57)	= 29.90
Prob > F	= 0.0000
R-squared	= 0.3441
Adj R-squared	= 0.3326
Root MSE	= .13634

ZubrinCd	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Comp2	.642776	.1175482	5.468	0.000	.4073897	.8781622
_cons	-.1459508	.097442	-1.498	0.140	-.3410751	.0491735

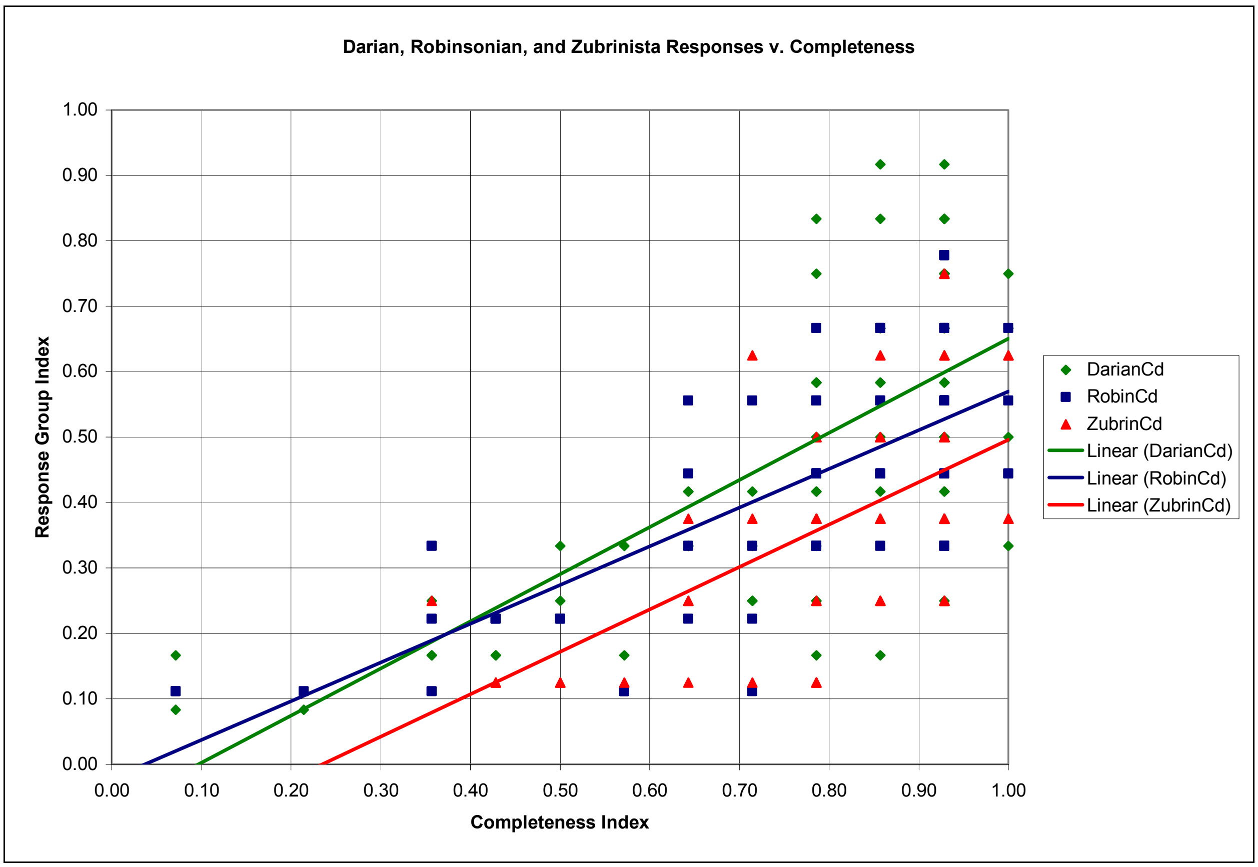

Figure 10: Scatterplot of Darian, Robinsonian, and Zubrinista Indices vs. Completeness Index

The crossing of the Darian and Robinsonian regression lines at the lower values, given the fact that the six lowest observations on the Completeness index are outliers, suggests the question, how would discarding these six observations affect the regression of the response groups on the

Completeness index? As might be anticipated, the slopes of all three groups increase. However, the correlation between the fidelity of the group's response to the design details of the particular calendar and the completeness of response shows its greatest improvement in the Darian group, which has an adjusted slope of 0.90 (see Table 27) vice the unadjusted value of 0.72. The correlation in the Robinsonian group also improved, with an adjusted slope of 0.75 (see Table 28) vice an unadjusted slope of 0.59. The Zubrinista group now has the weakest correlation versus the Completeness index with an adjusted regression slope of 0.71 (see Table 29), having only slightly improved over the unadjusted slope of 0.64. Again, the slopes are not the whole story. As can be seen in Figure 11, with the six outlying cases removed, the distinction between Darians and Robinsonians increases slightly, although the distinction between these two groups and the Zubrinistas does not change appreciably. However, none of these distinctions, either in slope or in *y*-intercept, is statistically significant at *P* = 0.05. For each response group, the 95% confidence intervals for the slope and *y*-intercept overlap those of the other groups.

Table 27: Regression of Darian Index on Adjusted Completeness Index

```
  Source |       SS       df       MS                  Number of obs =      60
---------+------------------------------               F(  1,    58) =   33.81
   Model |  .987880776     1  .987880776               Prob > F      =  0.0000
Residual |  1.69489253    58  .029222285               R-squared     =  0.3682
---------+------------------------------               Adj R-squared =  0.3573
   Total |  2.68277331    59  .045470734               Root MSE      =  .17095

------------------------------------------------------------------------------
DarianCd |      Coef.   Std. Err.       t     P>|t|       [95% Conf. Interval]
---------+--------------------------------------------------------------------
   Comp2 |   .9039022   .1554627      5.814   0.000       .5927098    1.215095
   _cons |  -.2256708   .1288905     -1.751   0.085      -.4836732    .0323316
```

Table 28: Regression of Robinsonan Index on Adjusted Completeness Index

Source	SS	df	MS		
Model	.682398443	1	.682398443	Number of obs =	59
Residual	.936265932	57	.016425718	F(1, 57) =	41.54
				Prob > F =	0.0000
Total	1.61866437	58	.027908006	R-squared =	0.4216
				Adj R-squared =	0.4114
				Root MSE =	.12816

RobinCd	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Comp2	.751484	.1165904	6.446	0.000	.5180157	.9849523
_cons	-.1587552	.0967378	-1.641	0.106	-.3524693	.0349589

Table 29: Regression of Zubrinista Index on Adjusted Completeness Index

Source	SS	df	MS		
Model	.57181565	1	.57181565	Number of obs =	58
Residual	1.02688264	56	.01833719	F(1, 56) =	31.18
				Prob > F =	0.0000
Total	1.59869829	57	.028047338	R-squared =	0.3577
				Adj R-squared =	0.3462
				Root MSE =	.13541

ZubrinCd	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Comp2	.7099149	.127129	5.584	0.000	.4552449	.9645849
_cons	-.2040386	.1061187	-1.923	0.060	-.4166198	.0085426

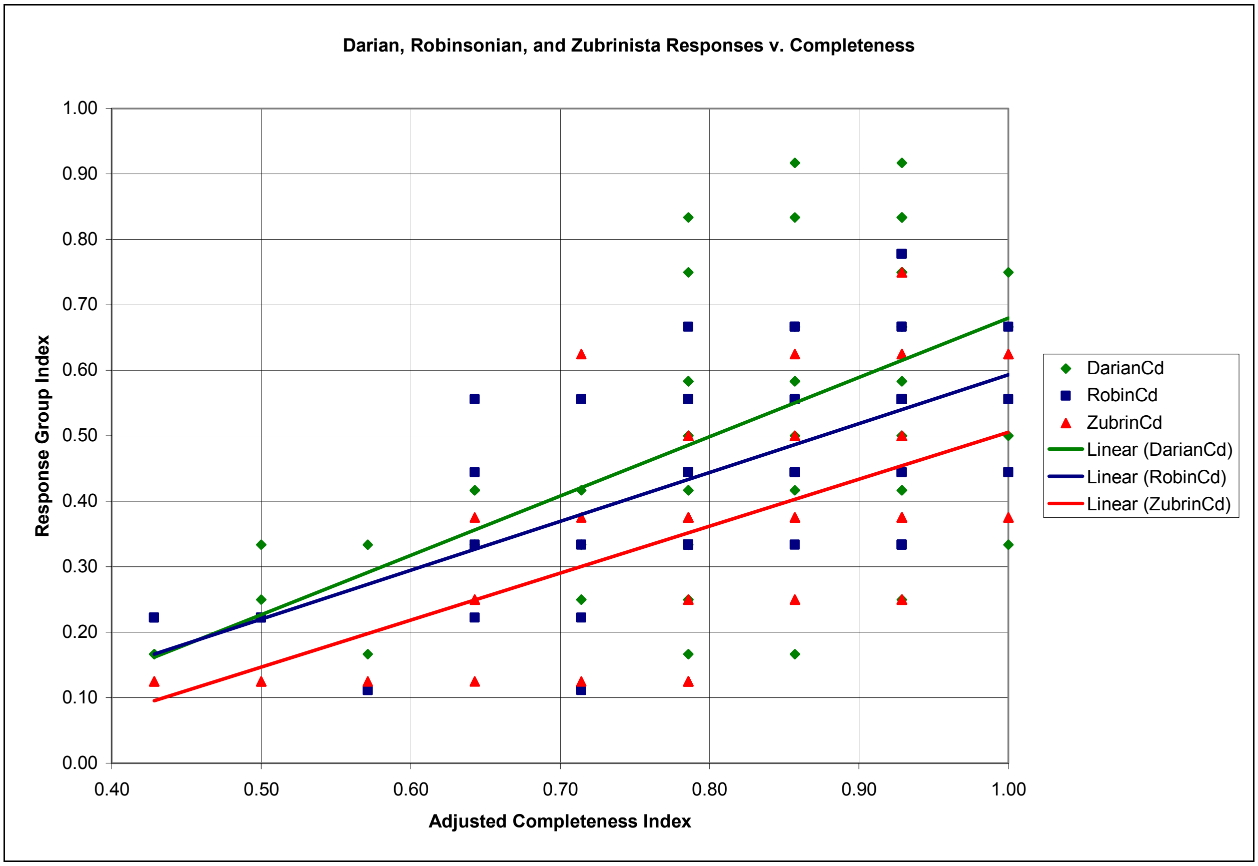

Figure 11: Scatterplot of Darian, Robinsonian, and Zubrinista Indices vs. Adjusted Completeness Index

Support for the 7-Day Week Across Month Length Preferences

Another question explored was whether the 7-day week has stronger support among respondents who prefer the length of the month to be some multiple of 7. Such an arrangement would result in an integral number of weeks per month, so that months would always begin on the same day of the week. A Chi-Square test of all of the responses to the Week1-1 survey question cross-tabulated with the responses to the Month1-1 survey question results in a table with 7 columns and 18 rows, or (7 – 1) x (18 – 1) = 102 degrees of freedom. However, 94 of the cells contain 0 observations, and a Chi-Square test is unreliable in the presence of so many thin cells. To eliminate the blank cells, it was necessary to collapse the cross-tabulation into responses favoring or opposing the 7-day week versus responses favoring or opposing a month length of some multiple of 7 (see Table 30). Even so, the table contains one cell with a value of 4.

Table 30: Chi-Square Test of 7-Day Week vs. 7x Month Length

Month Length	Week Length	7	Not 7	Total
Multiple of 7	Freq.	27	4	31
	Percent	87.10	12.90	
	E	23.00	8.00	
	(O – E)2 / E	0.70	2.00	2.70
Not multiple of 7	Freq.	19	12	31
	Percent	61.29	38.71	
	E	23.00	8.00	
	(O – E)2 / E	0.70	2.00	2.70
Total	Freq.	46	16	62
	Percent	74.19	25.81	100.00
	X^2			5.391

The null hypothesis is that support for the 7-day week and support for a month length of some multiple of 7 are independent in the population. The degrees of freedom for the two week length options and the two month length options are:

$$df = (2-1)\times(2-1) = 1$$

The calculation of X^2 is as follows:

$$E = \frac{rc}{n}$$

$$X^2 = \sum\frac{(O-E)^2}{E} = 5.391$$

The critical value of X^2 for statistical significance with 1 degrees of freedom at $P = 0.05$ is 3.841; however, the sample Chi-Square value is 5.391:

$P(X^2[1] > 5.391) < 0.025$

The null hypothesis can therefore be rejected. The research hypothesis, that support for the 7-day week and support for a month length of some multiple of 7 are related in the population, is supported.

Support for the 7-Day Week vs. a Perpetual Calendar

The positive results regarding a hypothesized relationship between support for the 7-day week and month length preference led to a more direct question. At the heart of the previous question was whether support for a rationalized relationship between the weekly and monthly calendar cycles is dependent on the preference for the 7-day week. This can be tested directly by comparing the responses to survey questions Week1-1 and Year1-4. As with Table 30, the various response options to these two questions have been collapsed into binary functions to eliminate thin cells.

Table 31: Chi-Square Test of 7-Day Week vs. Perpetual Calendar

Calendar Type	Week Length	7	Not 7	Total
Perpetual	Freq.	28	10	38
	Percent	73.68	26.32	
	E	27.77	10.23	
	(O – E)2 / E	0.00	0.01	0.01
Not perpetual	Freq.	10	4	14
	Percent	71.43	28.57	
	E	10.23	3.77	
	(O – E)2 / E	0.01	0.01	0.02
Total	Freq.	38	14	52
	Percent	73.08	26.92	100.00
	X^2			0.026

The null hypothesis is that support for the 7-day week and support for a perpetual calendar are independent in the population. Again, the critical value of X^2 for statistical significance with 1 degrees of freedom at $P = 0.05$ is 3.841; however, the sample Chi-Square value is 0.026:

$$P(X^2[1] > 0.026) >> 0.5$$

In this case, the null hypothesis cannot be rejected. Support for a perpetual calendar over a non-perpetual calendar exists across supporters of various week lengths.

Clock Preferences in the Calendar Response Groups

Another question that comes to mind is how support for the various clock proposals varies among the Darians, Robinsonians, and Zubrinistas. Table 8 shows that support for the stretched clock was double that of either the time-slip clock or some sort of decimal or semi-decimal clock, and four times the support for an octal or hexadecimal clock. Since Zubrin and I both favor the stretched 24:60:60 clock, one would expect support for this clock to be high among the Darians and Zubrinistas. The 24:60:60 + 00:39:35.2 time-slip clock is Robinson's invention, so support for it ought to be high among Robinsonians.

For the purposes of this Chi-Square test, the weighted values of responses on the Darian, Robinsonian, and Zubrinista indices were summed for each clock. The initial construction of the cross-tabulation included the decimal/semi-decimal clocks and octal/hexadecimal clocks; however, there were too few responses that correlated with responses to the calendar questions that were used to construct the Darian, Robinsonian, and Zubrinista indices, and this resulted in an unacceptable number of thin cells. The cross-tabulation (see Table 32) for this Chi-Square test therefore includes only the stretched and time-slip clocks. The null hypothesis is that support for these two clocks does not vary significantly between the hypothesized response groups.

Table 32: Chi-Square Test of Weighted Values, Calendar Response Groups vs. Clock Preferences

Clock		Darians	Robinsonians	Zubrinistas	Total
Stretched	Freq.	11.67	9.89	8.75	30.31
	Percent	38.50	32.63	28.87	
	E	11.68	10.38	8.25	
	(O – E)2 / E	0.00	0.02	0.03	0.053
Time-Slip	Freq.	4.08	4.11	2.38	10.57
	Percent	38.60	38.88	22.52	
	E	4.07	3.62	2.88	
	(O – E)2 / E	0.00	0.07	0.09	0.152
Total	Freq.	15.75	14.00	11.13	40.88
	Percent	38.53	34.25	27.23	100.00
	X^2				0.206

At first look, all of the frequency cells for the time-slip clock look thin (less than 5); however, these are weighted values. The actual number of observations for the two clocks correlated across calendar responses is given in Table 33. The difference weighting of the three indices is reflected in the columns of Table 32.

Table 33: Cross-Tabulation of Frequencies, Calendar Responses vs. Clock Preferences

Clock	Calendar Responses
Stretched	21
Time-Slip	7

The critical value of X^2 for statistical significance with 2 degrees of freedom at $P = 0.05$ is 5.991; however, the sample Chi-Square value is 0.206:

$$P(X^2[1] > 0.206) >> 0.5$$

Thus the null hypothesis cannot be rejected. Support for these two clocks does not vary significantly between the hypothesized response groups. The stretched clock enjoys substantial support over the time-slip clock across all calendar response groups, even the Robinsonians.

Conclusions

The construction of three indices based on the design details of three Martian calendars reveals that there are three distinct response groups with respect to preferences for the three calendars: the Darian, Robinson, and Zubrin. Univariate analysis showed that distributions within the three calendar response groups were normally distributed. There was very little skew in any of these distributions, and there were no outliers.

There were not enough defined design details for decimal or octal/hexadecimal calendars to study hypothetical response groups preferring these types of calendars.

The Completeness index constructed from the 14 survey questions on the structure of Martian time was non-normally distributed, exhibiting highly negative skew. This is explained by respondents' general desire to respond to most of the questions in the survey, given that they self-select to take the survey, rather than being randomly-selected. There were six low outliers.

A tabulation of the categorical "Clock" variable showed that stretched clock enjoyed the support of 35.6% of the respondents, whereas support for the time-slip clock was less than half this figure at 17.0%, as was support for some flavor of decimal or semi-decimal clock. Support for a clock based on some multiple of 8 was half again at 8.5%. Other responses not including "No opinion" accounted for an additional 22.0%.

A one-way analysis of variance showed that the difference in the means between the Darian, Robinsonian, and Zubrinista response groups is not statistically significant. Paired difference *t*-tests failed to reveal a relationship between any pair of indices.

Regression analyses showed that for all three calendar response groups, there was positive correlation between scores on the calendar response group index and the completeness of response index. Although both the level of completeness and the strength of correlation were highest in Darian responses, and lowest in Zubrinista responses, with the Robinsonians in the middle range, the differences between the three groups were not statistically significant at the 95% confidence interval.

A Chi-Square test revealed that support for the 7-day week and support for a month length of some multiple of 7 are related in the population. However, another Chi-Square test suggested that support for a perpetual calendar over a non-perpetual calendar exists across supporters of various week lengths.

Finally, a Chi-Square test of the calendar response groups vs. clock preferences failed to reveal a significant difference. The stretched clock enjoys substantial support over the time-slip clock across all three calendar response groups, even the Robinsonians, despite the fact that Robinson invented the time-slip clock.

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Appendix

NOTE: Some responses do not have coded values because there are no cases for those response options.

Variable	Value	Meaning
Day1-1		How many primary divisions should there be to the Martian day?
	8	8
	10	10
	12	12
	16	16
	20	20
	24	24
	2425	24 or 25
	25	25
	30	30
	32	32
	37	37
	60	60
	100	100
	360	360
	1000	1000
	0	No opinion
Day1-2		For 8 primary divisions, what pattern of smaller divisions should there be to the Martian day?
	8	8:8:8:8:8:8
		8:300:37
Day1-2		For 10 primary divisions, what pattern of smaller divisions should there be to the Martian day?
		10:50:20
	10	10:100:100
Day1-2		For 12 primary divisions, what pattern of smaller divisions should there be to the Martian day?
		12:12:12:12:12
Day1-2		For 16 primary divisions, what pattern of smaller divisions should there be to the Martian day?
	16	16:16:16:16
		16:150:37
Day1-2		For 20 primary divisions, what pattern of smaller divisions should there be to the Martian day?
	11	20:50:100
		20:74:60
Day1-2		For 24 primary divisions, what pattern of smaller divisions should there be to the Martian day?
		24:10:370
	244	24:10:1000
	240	24:60:60
	241	24:60:60 + 00:39:35

		24:(60:60 + 01:38 or 01:39)
		24:(60:60 + 99)
		24:60:(61 or 62)
	242	24:60:100
	243	24:100:100
Day1-2		For 24 or 25 primary divisions, what pattern of smaller divisions should there be to the Martian day?
		24:60:60 or 25:60:60
Day1-2		For 25 primary divisions, what pattern of smaller divisions should there be to the Martian day?
		25:40:88.7752409
	251	25:40:100
		25:50:71
		25:60:60
	250	25:100:100
Day1-2		For 30 primary divisions, what pattern of smaller divisions should there be to the Martian day?
		30:74:40
Day1-2		For 32 primary divisions, what pattern of smaller divisions should there be to the Martian day?
		32:40:40
Day1-2		For 37 primary divisions, what pattern of smaller divisions should there be to the Martian day?
		37:8:300
		37:10:240
		37:40:60
Day1-2		For 60 primary divisions, what pattern of smaller divisions should there be to the Martian day?
	60	60:60:60
		60:100:10
		60:100:100
Day1-2		For 100 primary divisions, what pattern of smaller divisions should there be to the Martian day?
		100:1000
Day1-2		For 360 primary divisions, what pattern of smaller divisions should there be to the Martian day?
	360	360:60:60
Day1-2		For 1000 primary divisions, what pattern of smaller divisions should there be to the Martian day?
	1000	1000:1000
	0	No opinion
Day1-3		Where should the Martian Date Line be located?
	0	0° Longitude
	180	180° Longitude
	1	No opinion
Week1-1		How many days should there be in a week?
	6	6 days
	7	7 days
	8	8 days
	9	9 days
	10	10 days

	14	14 days
	1	This unit should not exist
	0	No opinion
Month1-1		How many days should there typically be in a month?
	21	21 days (32 equal-duration months)
	2334	23 to 34 days (24 equal-arc months)
	2740	27 to 40 days (20 equal-arc months)
	28	28 days (24 equal-duration months)
	29	29 days (23 equal-duration months)
	2930	29-30 days (22-23 equal-duration months)
	30	30 days (22 equal-duration months)
	32	32 days (21 equal-duration months)
	33	33 days (20 equal-duration months)
	35	35 days (19 equal-duration months)
	37	37 days (18 equal-duration months)
	42	42 days (16 equal-duration months)
	4270	42 to 70 days (12 approx. equal-arc, integral-week months)
	4666	46 to 66 days (12 equal-duration months)
	5057	50 to 57 days (12 unequal months)
	56	56 days (12 equal-duration months)
	61	61 days (11 equal-duration months)
	67	67 days (10 equal-duration months)
	1	This unit should not exist
	0	No opinion
Year1-1		How many days should be added (or subtracted) in a leap year?
	1	1 day
	102	1 or 2 days (two types)
	2	2 days
	203	2 or 3 days (two types)
	3	3 days
	7	Entire 7-day week
	10	Entire 10-day week
	2930	Entire 29-day or 30-day month
	0	No opinion
Year1-2		For 1 leap days in a year, what should be the basic leap year scheme?
	1	Add one day as determined by observation (668, 669)
		Add one day every 2 out of 3 years, except every 15 years (6x668 + 9x669)
	35	Add one day every 3 out of 5 years (2x668 + 3x669)
	158	Add one day every 15/8 Earth years
	110	Add one day in odd years + decennial years (4x668 + 6x669)
		Atomic cycles, minor cycles, and major cycles (127x668 + 183x669)
		Subtract one day every 3 years + decennial years (12x669 + 18x670)
	49	Subtract one day every 51 years (50x687 + 686)
	0	No opinion
Year1-2		For 1 or 2 leap days in a year, what should be the basic leap year scheme?
		Add days as a function of the position of Earth
		Add one day in even years + one more day in decennial years (5x668 + 4x669 + 1x670)
		Add one day every 38 years + one more day every 590 years (574x667 + 15x668 + 669)
		No opinion

Year1-2		For 2 leap days in a year, what should be the basic leap year scheme?
		Subtract two days every 5th year (1x667 + 4x669)
Year1-2		For 2 or 3 leap days in a year, what should be the basic leap year scheme?
		Add two days every 5th year + one more day every 300th year [59x(4x668 + 1x670) + (4x668 + 1x671)]
Year1-2	305	For 3 leap days in a year, what should be the basic leap year scheme?
		3 leap days every 5th year (4x668 + 1x671)
		3 leap days every 5th year (4x669 + 1x672)
		No opinion
Year1-2		For 7 leap days in a year, what should be the basic leap year scheme?
		Add seven days in even years + every 35th odd year
	750	Add seven days in even years + every 50th odd year
		No opinion
Year1-2		For 10 leap days in a year, what should be the basic leap year scheme?
		Add ten days every 7th year + every 50th year [7x(1x660 + 6x670) + 1x670]
Year1-2		For 29 or 30 leap days in a year, what should be the basic leap year scheme?
		Add a 29-day or 30-day month every four years out of seven years 6x(3x652 + 4x681) + (3x652 + 3x681 + 682)
Year1-3		When should the leap days occur?
	1	Beginning of the year
	3	End of 1st month
	4	End of 1st, 2nd, and 3rd months
	5	End of 2nd month (of 12)
		End of 2nd month (of 22)
		End of 3rd month (of 24)
	6	End of 4th month (of 24)
		End of 5th month (of 12)
		End of 8th month (of 12)
		End of 11th month (of 16)
	2	End of 12th, 18th and 24th months (of 24)
		End of 13th month (of 24)
		End of 19th month (of 24)
		End of 22nd month (of 32)
	7	End of the year
	8	Mid-year
	9	Mid-year and end of the year
	10	Vernal equinox and autumnal equinox
	0	No opinion
Year1-4		What period of time should contain an integral number of weeks in order to effect a perpetual calendar?
	2	1 Month
	3	1 Year
	4	2 Years
	1	None
	0	No opinion
Year1-5		For the purpose of devising a perpetual calendar, which of the following deviations is most desirable?
	6	Shorten the week by one day, three to four times per year
	5	Shorten the week by three or four days at the end of the year
	2	Add a day that does not fall within the weekly scheme (a holiday), several times per year

	1	Add a day that does not fall within the weekly scheme (a holiday) in leap years
	3	Add 3 or 4 days that do not fall within the weekly scheme (holidays)
		Add 8 or 9 days that do not fall within the weekly scheme (holidays)
		Add 10 or 11 days that do not fall within the weekly scheme (holidays)
	0	No opinion
Epoch1-1		When should people begin using a Martian calendar?
	1	Now
	2	First human landing
	3	First permanent base
	0	No opinion
Epoch1-2		On what annual cycle should the Martian numerical year increment?
	2	Half Martian cycle
	3	Earth cycle
	4	Martian cycle
	0	No opinion
Epoch1-3		What event should begin the counting of calendar years?
		Fictional foundation of the global Martian state (22,982 BCE)
	-4712	Beginning of the Julian period (4713 BCE)
		Beginning of cyclical intercalation system (4225 BCE)
	1	Beginning of the Common Era (1 CE)
	1609	Beginning of the Telescopic Period (1609 CE)
	1707	Most recent Martian vernal equinox occurring on January 1st (1707 CE)
	1873	Simultaneous Earth midnight and Martian noon on their prime meridians (1873 CE)
	1961	Erroneous most recent Martian vernal equinox occurring on January 1st (1961 CE)
	1965	Mariner 4 flyby (1965 CE)
	1971	Mariner 9 orbit and Mars 3 landing (1971 CE)
	1976	Viking 1 landing (1976 CE)
		Viking 1 landing (1976 CE) and first human landing (undefined)
	1998	Founding of the Mars Society (1998 CE)
	2000	End of the 1900s (2000 CE)
	2001	Beginning of the 3rd millennium (2001 CE)
		Coincidence of the vernal equinoxes of Earth and Mars (2004 CE)
		Fictional first human landing (2012 CE)
		Fictional first human landing (2026 CE)
	5	First human landing (undefined)
	4	First permanent base (undefined)
	0	No opinion
Epoch1-4		At what time of the year should the calendar begin?
	10	Vernal (northward) equinox (L_S = 0.0°)
	5	Position of Mars on the founding of the Mars Society (L_S = 15°)
	2	Aphelion (L_S = 71.0°)
	9	Summer (northern) solstice (L_S = 90.0°)
		16 days after the summer solstice (L_S = 97.5°)
	11	Position of Mars on the Viking 1 landing (L_S = 98.5°)
		Autumnal (southward) equinox (L_S = 180.0°)
		Position of Mars at the beginning of the Julian period (L_S = 230°)
		Perihelion (L_S = 251.0°)
	12	Winter (southern) solstice (L_S = 270.0°)
	6	Position of Mars on 1 Jan 2000 (L_S = 274°)
	7	Position of Mars on 29 Dec 1873 (L_S = 277.2°)
	13	12 to 19 days after the winter solstice (L_S = 281°)

		107 days before the vernal equinox (L_S = 298.2°)
	4	Position of Mars on the Mars 3 landing (L_S = 302°)
		(L_S = 315°)
	3	Position of Mars at the beginning of the Common Era (L_S = 351°)
	1	Position of Mars on the first human landing (undefined)
		Position of Mars on establishing the first permanent base (undefined)
	0	No opinion
Epoch1-5		What number should begin the calendar count?
	0	Year 0
	1	Year 1
	1000	Year 1000
	1976	Year 1976
	2	No opinion