Gravimetric phases of the Moon: could they impact humans starting from birth?

(name(s) of author(s) are intentionally omitted in the draft; lulg998@gmail.com)

Abstract
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We look at the frequencies of natal Moon in the widely known 12 sectors starting at the vernal equinox point (the Zodiac signs), at the easily observable luminance phases, and at gravimetric phases, that is, sectors starting at the lunar apogee point.
We test the null hypothesis: the claim that the Moon's position, with respect to Zodiac, Sun, and to lunar apogee point, is indistinguishable from random at the moments when humans are born, and there is no correlation with their later appearing psychological traits, professions, and so on. For this purpose we use data from Archives Gauquelin, and two interchangeable Python packages, Pyswisseph and Ephem, for finding positions of Sun, Moon and apsides.
We find that data make it very hard to claim that the null hypothesis is true, at least when it comes to gravimetric phases. We provide all the data and all the software code in a repository on Github.com. We affirm that our Python script that calculates everything using Pyswisseph is essentially 40 lines long.[19]

Keywords
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Lunar cycles; Space weather; Chronobiology; Moon effect; Gravitational pull

1. Introduction
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The first of the Highlights of study [1] is the following:
"Whether human sleep is influenced by the lunar cycle is a matter of controversy."
The introduction of [1] contains a review of recent published works in the field, please see [1] for a review. There are actually six lunar cycles [17], but only one, the most well-known of the cycles, has been considered in [1]. For example, in [2]:
"The Moon exhibits three different cycles that affect moonlight intensity and gravity on Earth and that are illustrated in Fig.1". The main result of [2] is the following: "We show that women's menstrual cycles with a period longer than 27 days were intermittently synchronous with the Moon's luminance and/or gravimetric cycles."

We had no access to data collected by authors of [1] and [2], nor to any similar data, that is why we decided to use the data that are freely available: Archives Gauquelin.
Just like whether human sleep is influenced by lunar cycles is a matter of controversy, it is also controversial whether any space weather conditions, including lunar cycles, influence humans starting from the moment of their birth and later on.
The most influential study in this field was completed by Michel and Françoise Gauquelin more than 30 years ago. They published a quarterly research journal Astro-Psychological Problems[3] in 1982-1995, and many prominent researchers contributed to it, including Hans Eysenck, who, at the time of his death in 1997, was the living psychologist most frequently cited in the peer-reviewed scientific journal literature. Hans Eysenck made 11 contributions to Astro-Psychological Problems, 10 without and one with co-authors.

There is a brief summary of the controversy about the principal findings of Michel and Françoise Gauquelin in [4], here is a quote:
"Michel Gauquelin was a psychologist and statistician, and that was the foundation of his research. He used rigorous statistical tools to examine data in the context of astrological claims and scrupulously reported the results. He and his wife were skeptics, but they were driven by data, not belief. Over a series of publications covering several years, they reported a small but statistically significant relationship between some planetary positions at the time of the birth and later outstanding performance, most notably the position of Mars in a natal chart and later athletic prowess.[3-5] In 1978, Michel Gauquelin wrote a paper critical of astrology that was published in The Humanist.[6] Out of the paper grew a book debunking traditional Western astrology's planetary effects, also written by Gauquelin.[7] It was published in 1979 by Prometheus Books. But it was that small effect that did stand up to testing that became intolerable to Kurtz and many in CSICOP. A kind of minor modern Galileo trial then occurred, including a threatened excommunication. Gauquelin was pressed to recant. He would not; being a genuine scientist the data would not let him. This refusal led The Humanist group to attack him, and they chose to focus their attack on the Gauquelins' statistics,[8] but it soon became clear that Michel Gauquelin was the better statistician, and the denier case collapsed."

You can read more about principal findings of Gauquelin in [5] and [6].
We use Archives Gauquelin published on the CURA web site [7].

Also worth mentioning is the Shnoll effect discovered almost 70 years ago:
"Shnoll has investigated the non-Poisson scatter of rate measurements in various phenomena such as biological and chemical reactions, radioactive decay, photodiode current leakage and germanium semiconductor noise, and attributed the scatter to cosmophysical factors."[8]

2. Methods

2.1. Core design principles

Our core design is based on one fundamental assumption, from which we derive three groups of practical assumptions that have been implemented in the design. The fundamental assumption is seemingly simple: if there is any correlation between space weather conditions at time of birth, and what actualizes later, then the reasons of correlation are natural, not supernatural. The correlation is not due to angels or aliens, it is due to the physical laws of nature.

The first derivative is: we assume that those laws of nature apply to all humans, they do not work like "these are victims of the root cause of correlation, and other newborns were immune". We assume the correlation affects all newborns, at least to some extent. We assume the dispersion is not like "plus or minus 99 percent of the average value", it is probably closer to plus-minus 10% than to +-90%. We assume the anomalies that will appear on smaller samples are more likely to be statistical flukes than the anomalies that will appear on bigger samples. Due to these assumptions we make only three groups of Professional Notabilities, the groups corresponding to volumes A1, A2, A3 of Archives Gauquelin, and then we append Sports Champions from other volumes, namely D6 and D10, to Sports Champions from volume A1, append Scientists & Medical Doctors from other volumes to those from volume A2, and similarly to volume A3.

Another derivative is the following: we assume the space weather conditions that are due to Sun and Moon are more important than other similar conditions, especially those in which neither Sun nor Moon appear directly. We assume that if we try many criteria, and some of them give results that look like abnormal statistical flukes, the results from criteria with no Sun and no Moon are more likely to appear as statistical flukes indeed: anomalies that do not show up on other data. More likely than the anomalies arising from criteria that look similar, but are including Sun and/or Moon.

Third. We agree with authors of [9] about the following:
"If there was any correlation between astronomical factors and something about behavior of humans who were not aware of those factors, then most likely the correlation would be stronger between astronomical factors and something psychological, like personality traits, or biological/physiological, like gene expression patterns or microbiota activity patterns". Even if overall the methods used in [9] appear to us as overcomplicated and prone to errors, we assume the authors are correct about the following: there could be a correlation with psychological or biological/physiological factors, and then a correlation between the latter and the profession in which the person succeeds. This is derivable from our fundamental assumption. For this reason we include the Mental Patients group from Archives Gauquelin, in addition to the three biggest groups with Professional Notabilities. We assume the persons in the Mental Patients group are somehow different, on average, from the general population. In [20] the main conclusion is the following: "Psychiatric admissions for schizophrenia show lunar periodicities". In our Mental Patients group 28.05% of persons (1265/4510) have a schizophrenia diagnosis.
The groups from volumes A4, A5, A6 are a lot smaller. They could be made bigger by merging pairs or triples of professions, but it is not clear enough whether, for example, Actors should be merged with Politicians, or with Musicians, or what. Besides, that last table in [5] gives a hint, using methods that are not used in our study, that groups from volumes A4, A5, A6 are on average not as distinctive as groups emerging from volumes A1, A2, A3.

We also adapted the Python script provided by authors of [9] for fetching data from WWW. In our code you can choose whether to fetch data from http://cura.free.fr/gauq/ or from http://web.archive.org/web/http://cura.free.fr/gauq/

2.2. Ecliptic longitudes and 30-degree sectors

We use ecliptic longitudes of the Moon instead of the true positions, this makes no difference in our setting, since in all experiments we divide the ecliptic plane into twelve 30-degree sectors. The sectors are starting at the vernal equinox point in the first experiment, at Sun in the second, and at the interpolated lunar apogee point in the third experiment.

2.3. Python packages and the interpolated lunar apogee

We use two Python packages, Ephem[11] and Pyswisseph[12], the difference in the ecliptic longitudes they provide for Sun and Moon is very small, and for the interpolated lunar apogee point it is small enough to claim that you can use just one of the two packages, and ignore the other one.
Ephem is easier to install, especially on machines running OS Windows, but our Python source code for Pyswisseph is simpler, because Pyswisseph is able to calculate lunar apogee for an arbitrary moment. Pyswisseph is essentially a wrapper for the AstroDienst Swiss Ephemeris library, and is available from [13]. Swiss Ephemeris library is also available with C source code from Github.com [14].

We implemented an algorithm for calculating the interpolated lunar apogee for a given moment of time, and this is the main reason why our code for Ephem is about twice longer than the equivalent code for Pyswisseph. The algorithm applies the following formula:
longitude = (longitudeBelow + d*(timeT-timeBelow)/(timeAbove-timeBelow) + 360) mod 360
where
  timeT is the time for which we need to find the longitude of interpolated lunar apogee,
  timeBelow is the time of the closest true lunar apogee before timeT,
  timeAbove is the time of the closest true lunar apogee after timeT,
  longitudeBelow is the ecliptic longitude of the Moon at the moment timeBelow,
  longitudeAbove is the ecliptic longitude of the Moon at the moment timeAbove,
  d = longitudeAbove - longitudeBelow, it is adjusted so that -3.5 < d < 9, and we also assert that 26.5 < timeAbove-timeBelow < 28 and timeBelow <= timeT <= timeAbove.

For finding timeBelow and timeAbove more quickly, we at first find all such moments of time when Moon is exactly at the apogee point, for the range {minYear-1,maxYear+1}, where minimal and maximal years are known after the first pass through all moments of birth of persons in the given group. And then we use that array for quickly finding timeBelow and timeAbove (for a given timeT) using binary search.

The longitudes we obtain using the described algorithm are close enough to the output of Pyswisseph for the same. For information on the algorithm implemented in Pyswisseph, see [15].

2.4. Control groups

We have four target groups and, for each of the four, the three other groups may serve, to some extent, as control groups. We also build bigger control groups for each target group using the following method:
for each of the N sets {year,month,day,hour,minute,second} where N is the number of persons in the target group, we separate year from the other five components, and then make a combined control group from all the N*N tuples {Year, InsideY}, where InsideY is the set with five other components: date and time inside the year.
If an InsideY with February 29 is combined with a non-leap year, then February 29 becomes March 1. Both Python packages, Ephem and Pyswisseph, do this automatically, but we assert this in our code after importing these packages.

The control group created with this method has the same distribution of years as the target group, and an almost exactly same distribution of month-day-time inside each year. We do this because each target group has a unique distribution of years, and artifacts may arise due to such unique distributions.

2.5. Estimating p-values

We apply a chi-squared "goodness of fit" test, using the combined control groups, and a chi-squared test for independence to check whether our four target groups have the same distribution; function scipy.stats.chisquare() for the former, and scipy.stats.chi2_contingency() for the latter.
We use G-test provided by function scipy.stats.power_divergence() with lambda_=0 as an alternative "goodness of fit" test.

We also apply binomial tests to each of the 48 tuples {group, sector}, and for obtaining probabilities of success according to the null hypothesis we use the combined control groups.
For example, if in the control group the Moon is in sector 1 in 9.00% of cases, and in the target group it is in sector 1 for 8.00% of subjects, and target group contains 5000 subjects, then the probability of seeing 400 or fewer hits (given the probability of a hit 0.09 with respect to the null hypothesis) would be scipy.stats.binom.cdf(k=400, n=5000, p=0.09) ~= 0.0065.

3. Results

Table 1 (see Appendix) displays, for each of the four target groups, the percentages of Moon in the 12 sectors starting from the Vernal Equinox point (such sectors are more often called Zodiac signs). Part 2 of Table 1 contains the same for the combined control groups, we can see that in every column the values in the four rows are very close to each other. Part 3 displays the excesses or deficits in target group relative to the corresponding combined control group. Here we see the biggest difference -1614 in the (MP,1) cell, where the p-value would be estimated as 0.00088:
0.000882 with package Ephem,
0.000883 with package Pyswisseph.
-1614 indicates the 16.14% difference between the values in target and control groups:
7.007 / 8.356 - 1 = -0.16144,
where 7.007 is the percentage of the Moon in sector 1 in the target group,
while 8.356 is the percentage of the Moon in sector 1 in the control group.
The cells with the next two biggest differences are (A1,8) and (A1,12). Group A1 contains Sports Champions from all volumes, namely A1, D6, D10. The two estimated p-values are still rather small, 0.0173 and 0.0093, but because there are 4x12 cells in the table, we must take the number of tests (48) into account, and as a result, only the estimated p-value of the biggest difference in (MP,1) can be regarded as statistically significant.

The "goodness of fit" tests give the following p-values:

Pyswisseph		Ephem		
Chi-squared	G-test	Chi-squared	G-test	
0.0327874	0.0292175	0.0328622	0.0292822	-- volume A1, Sports Champions
0.2068393	0.2157595	0.2087962	0.2177466	-- A2, Scientists & Medical Doctors
0.6714513	0.6737251	0.6794911	0.6816778	-- A3, Military Men
0.1412975	0.1232717	0.1410164	0.1230112	-- MP, Mental Patients

P-values from chi-squared test for independence are 0.0321 and 0.0332 (Pyswisseph, Ephem).

Table 2 displays results of the same 4x12 tests for Moon in the 12 sectors starting from Sun. Here none of the estimated p-values is statistically significant.

Table 3 displays results of 4x12 tests for Moon in the 12 sectors starting from the interpolated lunar apogee, and here the biggest difference is again in the (MP,1) cell, and the estimated p-value for that particular cell is as little as
0.0000058 with package Ephem,
0.0000054 with package Pyswisseph.
Even if we multiplied it by 48, it would still be a statistically significant number.
But if the null hypothesis is true, then the following three facts are coincidences:
in Table 1 the biggest difference is in row 1;
in Table 1 the biggest difference is in column MP;
in Table 1 it is also a deficit, not an excess.
We estimate the probability of seeing them by chance, in either Table 1 or 2 (we include Table 2 despite of it showing no statistically significant results) as approximately 1/24.
The following tests do not take Table 1 into account, just Table 3.

The "goodness of fit" tests give the following p-values:

Pyswisseph		Ephem		
Chi-squared	G-test	Chi-squared	G-test	
0.3914598	0.4002657	0.3183718	0.3252293	-- A1
0.7125363	0.7177760	0.6471511	0.6545714	-- A2
0.6019536	0.6013366	0.5598743	0.5601778	-- A3
0.0044556	0.0028943	0.0056911	0.0037189	-- MP

P-values from chi-squared test for independence are 0.0491 and 0.0468 (Pyswisseph, Ephem).

After the first draft of this report was ready, we made a critical review of the design and methods, and noticed an implicit assumption: duration of the interval at the time of birth is so small that shifts of longitudes of Sun and Moon can be ignored.
Sun progresses by approximately one degree per day, however speed of the Moon is much higher: 360 degrees in 27.32 days, or ~13.177 degrees per day. Apogee and perigee points are ~9 times slower than Sun: progressing by one revolution in 8.85 years.
If we add N degrees to every longitude of the Moon when calculating the sector number, 1...12, then we are essentially calculating the sector number, 1...12, for the center of the area that starts at the position of the Moon, and has a width of 2*N degrees.
We tried N=1, N=2, N=3, and discovered that with N=2 the estimated p-value for (MP,1) in Table 3 becomes ~20 times smaller. This is an important result, especially given that the sector number changes in only ~1/15 of cases. This result suggests that the center

of the 4-degree-wide area that starts at the position of the Moon could be more important than the point marking the beginning of the area, that is, position of the Moon per se. Moon progresses by 4 degrees of ecliptic longitude in approximately 7.3 hours.

Furthermore, we were able to reproduce in our framework the main results of the first half of Table 12 of study [18], where we see deviations as big as +3.53, -3.19, +3.09 standard deviations in the cells (A1,4), (A2,4), (A3,7) respectively.
Our framework has the same group types and same aspects, but the target group contents are a bit different, as are the control group methods, and the statistical methods we apply.
Sizes of groups are as follows:
A1 - 2887 vs 2886 - our study and [18] respectively,
A2 - 4693 vs 4716,
A3 - 3920 vs 4482 - because we do not use data from the unpublished volume F2,
MP - 4510 persons.
In our framework there are four target groups, thus the table would be 8x4. The p-values we see in cells (A1,4), (A2,4), (A3,7) are 0.0042, 0.0067, 0.0061 respectively, with package Ephem. We made a step forward in the research, and ran the same with all seven planets (instead of all five planets visible with the naked eye, as in [18]) and observed that in this case the p-values in cells (A1,4), (A2,4), (A3,7) are 0.003, 0.034, 0.00005.

4. Discussion

The anomaly we described looks like it is due to a previously unknown correlation.
We speculate that maybe to some extent this remained unexplored because computing the interpolated lunar apogee for an arbitrary moment of time is a non-trivial task.
Our findings are correlational and therefore causation cannot be determined. It is too early to speculate about the possible reasons, but research can be done whether microorganisms, plants or animals are able to detect gravimetric phases of the Moon.

The authors of [1] remind us that "It must, however, be borne in mind that the overall gravitational pull of the moon on a single human subject is minuscule".
True, but the range apogee-perigee is quite big:
~25% difference in gravitational pull, Moon at average apogee vs average perigee, see [16].
~30% difference in gravitational pull, Moon at farthest apogee vs closest perigee, because in [16] we read "The orbit changes over the course of the year so the distance from the Moon to Earth roughly ranges from 357,000 km to 407,000 km". If gravitational pull from distance 407K is one unit, then the pull from distance 357K is (407/357)^2 = 1.2997 units.

In [2] we read the following: "We show here that menstrual cycles were intermittently synchronous with the luminescence and/or gravimetric cycles of the Moon..." And then "atmospheric pressure cycles are measurable during perigee-syzygy tides (32), and there are initial reports that terrestrial plants and animals can sense them (33, 34). In addition, the Moon affects Earth's magnetotail, thereby creating oscillating electromagnetic fields on Earth's surface that can be sensed by animals (35, 36). Perhaps humans can sense all these types of oscillations, as well (29, 31, 35)."

If we assume it is true that (some) terrestrial plants and animals can sense gravimetric lunar cycles, then we probably should assume that individual cells can sense such cycles, because seemingly plants and animals do not have a dedicated organ with such sensors, and because humans who are sensitive to non-trivial space weather conditions are usually consciously unaware of them, until they cause pain or something else well noticeable.
We can further speculate that if microorganisms are able to detect lunar cycles (including even cycles as improbable as Moon-Neptune cycle) that could be a result of an arms race between (genomes of) microorganisms: it was not so hard for them to learn the Earth-Moon, Sun-Moon and Sun-Earth-Moon cycles, but then some of them learned the Venus-Moon cycle, then after millions of years of evolution the Mars-Moon cycle, and so on, maybe up to Neptune. Supposedly the microorganisms that are better adapted to various cosmophysical factors, including the cycles, have an evolutionary advantage: better prediction of harmful and helpful weather conditions, and of behavior of other species; even if the advantage is rather small, it could accumulate during billions of years of evolution of life on Earth. Besides, due to a better synchronization, the unicellular organisms can become quasi-multicellular, that is, closer to acting like those truly multicellular. And there is no doubt that the multicellular organisms are higher on the evolutionary ladder than the unicellular, and are overall more powerful than the unicellular.

We can also extend the a-priori speculation -- "there could be (1) a correlation between space weather factors and psychological or biological/physiological factors, and then (2) a correlation between the latter and the profession in which the person succeeds" -- as follows: in case of Sports Champions the correlation between biological/physiological factors and the profession (in which the person succeeds very well) is stronger, on average, than in the other groups of Professional Notabilities.

One concern about our study could be due to the possibility of biased data in Archives Gauquelin. In [5] we see: "Objection: Gauquelin's findings are due to biased sampling". Even if to some extent the data were biased, that would not be a problem for our study, because, to the best of our knowledge, no one ever studied gravimetric phases using AG, nor calculated lunar apogee, nor Moon in sectors starting from apogee, for AG subjects.

A pervasive concern about studies considering Zodiac signs is the following: "People know their Zodiac signs and have beliefs about them". That is not a problem in our case because the percentage of people knowing position of the Moon at their time of birth is close to zero, and percentage of people knowing position of interpolated lunar apogee is extremely close to zero. Besides, astrology can tell not as much about Moon in Zodiac signs as about Sun, very little about apogee, and almost nothing about position of the Moon relative to apogee.

The framework we provide is rather simple yet quite powerful. You can use it for looking at distributions of *point1* is sectors starting from *point2* for any *point1* and *point2*, e.g. Saturn in sectors starting from Sun, or for any angles, not only 360/N degrees, N=1...8, as in [18] and in our codebase, folder /aspects/ reproducing results of Table 12.1 in [18].

5. Conclusion

We discovered an anomaly that suggests that there is a previously unknown correlation. We show that data make it very hard to claim that the null hypothesis is true, at least when it comes to gravimetric phases of the Moon, that is, longitude of the Moon with respect to the longitude of interpolated lunar apogee. We also provide a relatively simple framework that can be and should be applied to new data.

References

1. Christian Benedict, Karl A. Franklin, Shervin Bukhari, Mirjam Ljunggren, Eva Lindberg. Sex-specific association of the lunar cycle with sleep. Science of The Total Environment, Volume 804, 2022, 150222, ISSN 0048-9697. https://doi.org/10.1016/j.scitotenv.2021.150222
2. C. Helfrich-Förster, S. Monecke, I. Spiousas, T. Hovestadt, O. Mitesser, T. A. Wehr. Women temporarily synchronize their menstrual cycles with the luminance and gravimetric cycles of the Moon. Science Advances, Vol. 7, No. 5, 2021. https://www.science.org/doi/abs/10.1126/sciadv.abe1358
3. Publications of the Gauquelin Laboratory (L.E.R.R.C.P.) http://cura.free.fr/gauq/902gdG.html
4. Stephan A. Schwartz. False Equivalencies and the Mediocrity of Nonlocal Consciousness Research Criticism. https://www.skepticalaboutskeptics.org/wp-content/uploads/2014/09/false-equivalencies-and-the-mediocrity-of-nonlocal-consciousness-research-criticism.pdf
5. Ken Irving. Misunderstandings, Misrepresentations, Frequently Asked Questions & Frequently Voiced Objections About the Gauquelin Planetary Effects. https://planetos.org/mmf.html
6. Suitbert Ertel and Kenneth Irving, The Tenacious Mars Effect. London: Urania. https://www.scribd.com/document/489846178/Suitbert-Ertel-Kenneth-Irving-The-Tenacious-Mars-Effect
7. Archives Gauquelin published on the CURA web site. http://cura.free.fr/gauq/17archg.html
8. David P. Rothall, Reginald T. Cahill. Dynamical 3-Space: Gravitational Wave Detection and the Shnoll Effect. https://arxiv.org/pdf/1307.7437.pdf
9. Undisclosed authors. Machine Learning From Archives Gauquelin. https://openreview.net/pdf?id=lo5X9o_VM4
10. Python code for fetching all data from Archives Gauquelin. https://gitlab.com/MLAG-hub/mlag/-/tree/master/AG_data
11. Ephem, a Python package for performing high-precision astronomy computations. https://pypi.org/project/ephem
12. Pyswisseph, Python extension to AstroDienst Swiss Ephemeris library. https://pypi.org/project/pyswisseph
13. Pyswisseph code repository on Github.com. https://github.com/astrorigin/pyswisseph
14. Swiss Ephemeris code repository on Github.com. https://github.com/aloistr/swisseph
15. Swiss Ephemeris documentation, paragraph 2.2.4. The Interpolated or Natural Apogee and Perigee. https://www.astro.com/swisseph/swisseph.htm#_Toc58931075
16. Moon Fact Sheet. https://nssdc.gsfc.nasa.gov/planetary/factsheet/moonfact.html
17. Peter J. Marko. The Lunar Effect Bibliography. https://www.academia.edu/34621653/The_Lunar_Effect_Bibliography_Preview_pdf
18. James Gunasekera. New patterns in Gauquelin data. https://vixra.org/pdf/1106.0036v1.pdf
19. This study's repository on Github.com. https://github.com/g-p-m/GPM
20. Ran-Ran Wang, Yu Hao, Hua Guo, Meng-Qi Wang, Ling Han, Ruo-Yun Zheng, Juan He, Zhi-Ren Wang. Lunar cycle and psychiatric hospital admissions for schizophrenia: new findings from Henan province, China. Chronobiology International, vol. 37, num. 3, pages 438-449. 2020. https://doi.org/10.1080/07420528.2019.1625054

Appendix
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Table 1. Moon in sectors starting from Vernal Equinox (aka Zodiac signs).

1	2	3	4	5	6	7	8	9	10	11	12	Sector/Group
Part 1, Target groups, numbers are percentages multiplied by 1000:												
7007	8381	8714	7871	8670	8226	8869	8803	8537	8226	8470	8226	MP
8571	8622	8240	8699	8010	7934	8648	7908	8444	9056	8061	7806	A3
7991	7756	7991	8118	8118	8545	7969	8438	8992	8886	7927	9269	A2
8244	8001	9110	9283	8278	8971	8417	7135	8902	7897	8729	7032	A1
Part 2, Control groups, also percentage*1000:												
8356	8365	8302	8294	8312	8398	8337	8346	8240	8389	8341	8319	MP
8309	8343	8331	8342	8318	8352	8319	8356	8340	8318	8324	8347	A3
8294	8332	8356	8352	8330	8316	8340	8340	8367	8325	8308	8340	A2
8352	8347	8366	8259	8282	8292	8370	8355	8343	8316	8357	8361	A1
Part 3, excess or deficit: (Target/Control-1)*10000												
-1614	19	496	-510	431	-205	638	548	360	-194	155	-112	MP
315	334	-109	428	-370	-500	395	-536	125	887	-316	-648	A3
-365	-691	-437	-280	-255	275	-445	118	747	674	-459	1114	A2
-129	-415	889	1240	-5	819	56	-1460	670	-504	445	-1590	A1

Table 2. Moon in sectors starting from Sun.

1	2	3	4	5	6	7	8	9	10	11	12	Sector/Group
Part 1, Target groups, numbers are percentages multiplied by 1000:												
8381	9202	8625	8492	8182	8470	8470	7539	7960	8359	8248	8071	MP
7959	8316	9082	8138	7500	8291	8801	8036	8316	8265	8827	8469	A3
7841	8140	8182	8545	7820	8502	8886	8459	8246	8715	8822	7841	A2
8521	7828	9144	8382	7932	8209	7863	8105	8660	8452	9075	7828	A1
Part 2, Control groups, also percentage*1000:												
8215	8317	8420	8484	8284	8227	8246	8321	8443	8437	8354	8252	MP
8197	8327	8446	8483	8313	8198	8231	8346	8464	8425	8358	8212	A3
8191	8304	8489	8462	8352	8154	8255	8303	8442	8461	8362	8225	A2
8225	8381	8396	8429	8309	8209	8211	8328	8498	8478	8359	8176	A1
Part 3, excess or deficit: (Target/Control-1)*10000												
202	1064	243	9	-123	295	272	-940	-572	-92	-127	-219	MP
-290	-13	753	-407	-978	113	693	-371	-175	-190	561	313	A3
-427	-197	-362	98	-637	427	764	188	-232	300	550	-467	A2
360	-660	891	-56	-454	0	-424	-268	191	-31	857	-426	A1

Table 3. Moon in sectors starting from the interpolated lunar apogee.

1	2	3	4	5	6	7	8	9	10	11	12	Sector/Group
Part 1, Target groups, numbers are percentages multiplied by 1000:												
7339	9113	9002	8714	8071	7384	7140	7627	7761	9157	9047	9645	MP
8980	9056	7985	8444	7423	7474	8010	8112	8648	7857	8622	9388	A3
8651	8864	8523	7756	7586	7415	8097	8353	8161	8310	9312	8971	A2
10253	9352	8001	8244	6997	8486	7516	7690	7932	8556	8452	8521	A1
Part 2, Control groups, also percentage*1000:												
9246	8951	8539	8093	7683	7538	7432	7688	8099	8484	8945	9303	MP
9208	8962	8565	8013	7697	7558	7451	7631	8142	8513	8952	9308	A3
9216	8933	8558	8072	7685	7485	7502	7719	8064	8544	8917	9304	A2
9248	8981	8551	8025	7726	7552	7423	7707	8048	8545	8957	9237	A1
Part 3, excess or deficit: (Target/Control-1)*10000												
-2063	181	542	767	505	-204	-393	-79	-417	793	114	368	MP
-248	105	-677	538	-356	-111	750	630	621	-771	-369	86	A3
-613	-77	-41	-391	-129	-94	793	821	120	-274	443	-358	A2
1087	413	-643	273	-944	1237	125	-22	-144	13	-564	-775	A1