

Panchanga - Tantra

The Magic of the Indian Calendar System

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ABSTRACT

The Indian calendar system is one of the most complex sets of calendar-based rules in the world. Through a seemingly arbitrary mechanism, certain days, months and even years may be skipped, while others may be repeated. Moreover, calendrical practices seem to be differentiated based on region; a certain Indian state might celebrate its new year on certain day, while another one might celebrate months later. In this project, we explore this complexity, paying particular attention to links between the regional variations. In addition, we also computationally analyse the phenomenon of *kshaya maasas* or decayed months in the Indian lunisolar calendars. *Kshaya maasas* are a unique feature of the Indian lunisolar calendar, where, under certain conditions, a whole month may actually be dropped. In our study, we modelled past occurrences of a *kshaya maasa* and tried finding astronomical commonalities between them. The mode of narration is a post-modernist take on an 11th century Indian mathematical treatise, the *Leelavati Ganitam*.

1) REGIONAL COMPLEXITY

We classified all Indian calendars to be based on lunisolar, solar or mathematical rules. We analysed the regional variation in calendar rules based on the following elements: -

- 1) Basis of Calendar
- 2) Local Variation of generic calendar rules
- 3) The beginning of the year in the respective calendar, and
- 4) The Era followed.

Following these metrics, we described the following calendars: -

- 1) The Southern Amanta Calendar
- 2) The Western Amanta Calendar
- 3) The (Northern) Purnimanta Calendar
- 4) The Malayali Solar Calendar
- 5) The Oriya Solar Calendar
- 6) The Tamil Solar Calendar
- 7) The Bengali Solar Calendar
- 8) The National Calendar of 1957 CE
- 9) The Nanakshahi Calendar

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We gave a state-wise listing of the calendars being followed. We also provided an UML-based diagram listing the hierarchy and the links between individual calendars.

2) RULES FOR NAMING MONTHS

Having described the calendars involved, we go on to describe the rules by which the months are named. A taxonomic understanding of the calendar system is crucial because the same set of names are used for apparently disparate months determined on lunisolar, solar and mathematical bases. However, we showed that all Indian months are based on the following two rules: -

i) Months named after *nakshatras*

Allowing for minor regional variations in pronunciation and spelling, most Indian calendars use the set of names. However, as stated earlier, this gives rise to confusion and a certain amount of chaos in understanding calendars. Analysing how these month names have been used historically, we defined a rule by which months may be defined across calendars. We stated that, “the *amanta* and the solar months take the name of the *puṇimanta* month in which they start, whose name in turn is dependent on the approximate *nakshatra* occurring on *puṇima* (full-moon) of that month”. We also listed a mapping of each individual *nakshatra* to the corresponding month in a few of the calendars.

ii) Months named after *raasis*

While months named after *nakshatras* are seemingly ubiquitous, there are some Indian calendars that name their months according to *raasis* or solar constellations. In particular, in Kerala and in certain parts of Orissa, months are named according to the prevalent *raasi*. We gave a listing of months named according to such a rule.

3) DECIDING FESTIVALS

Arguably, the most popular use of the Indian calendars is in deciding when to celebrate a particular Indian festival. This is a matter of particular interest to Singapore as Indian festivals such as Deepavali are national holidays here as well. In this section, we give a listing of all the festivals officially recognised by the Indian government (and the corresponding state governments), giving their corresponding dates in the respective Indian calendars, and any additional rule for transcribing a lunar-day festival to fit a solar day.

4) LISTING OF ERAS USED

The complexity of the Indian calendars is further enhanced by the usage of a wide number of eras. For the purpose of a calendar, we define an era to be the year from which all the other years of the respective calendar are calculated. Without attempting to link calendars with individual eras, we analysed them according to the following metrics: -

- 1) Zero Year
- 2) Beginning of an individual year

We studied the characteristics of the following eras used in Indian calendars: -

- 1) Vikrama Era

- 2) Saka Era
- 3) Kali Yuga
- 4) Kollam Era
- 5) Bengali San

In addition, we also studied the hybrid eras such as the Jovian Cycle, describing the Northern and Southern schools of thought involved in the naming of the years.

5) ANALYSING KSHAYA MAASAS

The *Kshaya maasas* or decayed months are another interesting aspect of the Indian lunisolar calendar. Every 63 years or so, a month is expunged from the Indian lunisolar calendars. We analyse the modalities involved in this phenomenon, paying particular attention to the cultural and astronomical detail involved.

Definition

We started the analysis by defining a *kshaya maasa*. We defined a *kshaya maasa* to be thus: - “In any given lunar year, if two consecutive *Samkrantis* occur between two consecutive new moons, then the lunar month, whether *amanta* or *purnimanta*, with the same name as the solar month in which this occurs, is dropped”. This rephrasing was particularly useful for computational modelling.

Computational Analysis

We modelled all occurrences of *kshaya maasas* between 1200CE and 2000CE using the *calendrica* code provided by Dr. Reingold and Dr. Dershowitz along with their book, *Calendrical Computations – The Millennium Edition*. We tabulated the timing of corresponding *Samkrantis* and *Amavasyas* for the beginning and the end of each *kshaya maasa*. In all cases, we note that the *Samkrantis* occurred between the *Amavasyas*. In addition, nothing that *kshaya maasas* occur with gaps of 19, 46, 65, 76, 122 or 141 years, we modelled the beginning and ending of the months of Margasira, Pausa, and Magha, the four lunar months in which *kshaya* has been documented to occur. Graphical representations of all months have been provided.

Astronomical Analysis

Indeed, as noted earlier, one of the curious aspects about *kshaya maasas* is that they occur in gaps of 19, 46, 65, 76, 122 or 141 years only. We explored this recurrence on the basis of the Metonic Cycle, the synodic month and the anomalistic month. We study the frequency with each of the above mentioned gaps occurred throughout the last 1500 years, noting that *kshaya maasas* occurred the most with gaps of 19 and 141 years respectively. We calculated the number of solar days in whole numbers of solar years, synodic months and anomalistic months, observing that the numbers match the closest in years of recurrent *kshaya* occurrence.

Schools of Kshaya Thought

The final aspect about *kshaya maasas* is how they're dealt with in corresponding Indic lunisolar calendars. Chatterjee points to the following three schools of *kshaya* usage: -

- 1) North-western

- 2) Southern
- 3) Eastern

We discuss specifically which calendars follow which school, how each school incorporates the *kshaya maasa* into its calendar and how it deals with the additional intercalary month that occurs in a *kshaya* year.

CONCLUSION

The Indian Calendar system is still a complex web of regional astronomical rules. Through this project, we attempted to harmonise the over-reaching chaos by listing all the calendars, festivals and eras followed. We tried defining an all-inclusive rule for naming months. And finally, we also analysed the phenomenon of *kshaya maasas* by defining and computing past occurrences and by attempting to provide for an astronomical justification for it.

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