MISCELLANEA I
Pi

Miscellaneous is always the largest category.
-- Walter Slovotsky, "The Warrior Lives" by Joel Rosenberg

Pi verses in Sanskrit

1

Several Sanskrit verses (...) are found in the book Vedic Mathematics by Sri Bharathi Krishna Thirthy (...) which appeared in 1978 in Delhi.

There you will also find many poems which give astonishingly accurate geometrical constructions to approximate pi. Also the classical Newton-Leibniz formula for pi/4=1-1/3+1/5 etc. was know to the ancient Hindus and appears in several classical works, mostly disguised in poems, for instance in Tantra Samgraha. There you will find among many others the following interesting poem:

Vyasavargadravihatat pada,syat prathamam phalam
Jatastattat phalachchapiyavadischantribhirharet
Rupadyayugmasancyabhirllabdeshweshuyathacramam
Vishamanam yutetyacte yugmayoge vritirbhavet.

Difficult to read and to understand. The translation is

Multiply any given diameter squared by 12 and extract the root of the product. this is the first quote. Divide the first by 3 for the second quote; this second and each so obtained quote devide by 3 continually,
place them in order and devide them by the odd numbers 1,3,5,etc. Add together the first, 3., 5. etc. quotes and also the second, 4., 6. etc. Then subtract the sum of the even from the odd and the remainder will be the circumference of the circle, whose diameter was given.

The measure if this poem is Anushtubvrittam, comparable (well, more or less)
to the hexameter in classical Greek literature.

The poem gives the following infinite series expansion:
C=sqrt(12)x(1-1/3.3+1/5.3^2-1/7.3^3+1/9.3^4-1/11.3^5 etc.).

It is interesting that this formula is known in Europe as Machin's formula, after John Machin (1685-1751), which he derived by a transformation of the Taylor series of the arctangent function.

From: Walter Boehm

Here are a few verses in Sanskrit which give values of pi:

1) caturadhika.m s'atamashTaguNa.m dvAshashTistathA sahasrAnAm
ayuta-dvaya-vishkambhasyAsannO v.rtta-pariNAha.h

this means that 100+4, multiplied by 8 and added to 62000 is nearly the circumference of a circle of diameter 20000. (thus we have the approximation 62832/20000=3927/1250=3.1416)

2) v.rttavyAsE hatE nAgavEdavahnyabdhikhEndubhi.h
tithyas'vivibudhairbhaktE susUkshma.h paridhirbhavEt

which gives the better approximation 104348/33215.

(There is also a formula for the value 2,827,433,388,233/900,000,000,000).

3) vyAsE vAridhinihatE rUpah.rtE vyAsasAgaramabhihatE
tris'arAdi-vishama-sa.mkhyA-bhakta.m .rNa.m sva.m p.rthak-kramAt kuryAt

which describes a series representation for the EXACT value of pi, namely pi/4 = 1 - 1/3 +1/5 - 1/7 + 1/9 -..., which is related to what is now called the Madhava-Gregory-Leibniz series.

I should say that there are formulae for more rapidly convergent series as well.

Remarks:
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1) .r is usually written `r' with a dot UNDER it; similarly for .h. For .m, the dot goes ABOVE. Also, s' is for the palatal sibilant, and is printed as an s with an acute accent. Vowels in capitals are long (A=aa, etc).

2) The system used to express numbers in these citations is based on word-numerals, and numbers are written with units FIRST. For example, vEda = 4 because there are four texts called the Vedas, etc. This system is convenient for expressing results in poem form, and was used concurrently with

a system which gave rise to modern numerals. See e.g. G. Guitel's book on the history of written numerations for instance, for some details.

3) Words in Sanskrit are attached to one another by phonetic rules, which explains the inordinate length of passages without blanks. I have added some hyphens for clarity.

I should say that almost any treatise in Indian Mathematics has at least one poem of this type, and I only tried to give a representative sample. The first and third are fairly famous and have been discussed extensively.

[Addendum]

I should have added another approximation for pi, expressed in the kaTapayAdi system (which associates letters to numbers in a particular way, and which is still used in South Indian music in particular):

It gives "caNDA.ms'ucandrAdhamaku.mbhipAla" for a circumference of 31,415,926,536 corresponding to a diameter of "AnUnanUnnAnananunnanutyam", namely 10,000,000,000.

From: Satyanad Kichenassamy

Pi Names
Arabic

In my school days (1960's) we used the Arabic letter `Ta' (heavy T) for Pi; it might have come from the word `muheet' meaning cicumference or perimeter. It is also the ninth letter in the alphabetic numbering system which was common in poetry. Later they switched to the Greek letter Pi. I did look in the Treatise of Ikhwan Al-Safa (a 10-th century moslem equivalent of Bourbaki) but could not find anything.

Of course in those days the value 3.1415... was not known to them (they did not even have the decimal point as you surely know). What I meant was related to the possibility of any linguistic significance of Pi in those texts, but then I do not know what did these people denote Pi with. There are no Arabic texts that I know of in the last century or even early this century (except perhaps some school books that I have not seen) dealing with mathematics. So if such books exist they might contain some sort of mnemonics. We had some in physics and trigonometry and chemistry in

my
school days, but nothing on Pi (which we took to be 22/7).

From: Haidar Khajah

Chinese

More than 1,000 years ago the greatest Chinese mathematician
Zu, Chongzhi calculated pi(=3.1415926...), called Yuan Zhou Lu in
Chinese. He spent several years to obtain this results.

From: Xionghui He

Hebrew Pi

From: Jochen Katz <jkatz@math.gatech.edu>
Date: 7 May 1996 21:19:40 -0700
Newsgroups: soc.religion.islam
Subject: Explain this (was Re: Probabilities and 19)

This article does both:

Killing one of the Khalifa miracles
and presenting one of the Bible "miracles".

(...)

And as desert, here comes a Biblical "math miracle":

1 Kings 7:

23 He [Solomon] made the Sea of cast metal, circular in shape,
measuring ten cubits from rim to rim and five cubits high.
It took a line of thirty cubits to measure around it.

So, seemingly the Bible tells us that the circumference [30] = 3 x diameter [10]
and "obviously" the this is not true, so that the Bible is not from God or so some people like to reason, since pi is not equal to three? Well, apart from the
fact that 3 is less than 5% inaccuracy compared to the real value of PI = 3.1415...
and an acceptable approximation, there is actually something fascinating in this
verse:

---------- Forwarded message ----------
Date: Mon, 19 Feb 1996 19:53:49 -0500
From: Antreas P. Hatzipolakis <xpolakis@hol.gr>
To: math-history-list@maa.org
Subject: Hebrew Pi mnemonic ?

I repost a recent posting to SCSoviet:

From: simon1@bu.edu (Simcha Streltsov)
Date: 16 Feb 1996 18:30:44 GMT
Newsgroups: soc.culture.soviet

Antreas P. Hatzipolakis (xpolakis@prometheus.hol.gr) wrote:
(...)

Here is, probably, a very old mnemonic
(Book of Kings ch. 7, verse 23):

King Solomon builds a pool with the PI=3, but the word
"circumference" (Kava in Hebrew) is written with an extra letter.

As all letters are also numbers in Hebrew, we can take the ratio
of unusual form to the regular (kuf, vuv, hey vs. kuf, vuv)

(111 / 106) = (3.14159 / 3)

Simcha Streltsov, _Former_ Adar Rabbi of S.C.Soviet

Note:
Alexander Bakharev's response: 3.14150943396226/3 actually

Now, what does the Qur'an tell us about the value of the number PI?
Can you match that miracle?

At least something objective here. Nothing about "random events" and chance.
And this is especially astounding since the old Hebrews were very bad in math
generally and have hardly left anything in that field to posterity.

Jochen Katz

Response:

From: shawki Hamdan <shawki@ix.netcom.com>
Date: 09 May1996
Newsgroups: soc.religion.islam
Subject: Explaination this once more for Jochen

Jochen Katz wrote:

(...)

So, to your point. We know from Ebla that the ancient Semites, in fact, had a relatively highly advanced knowledge of basic mathematical laws. Should it then surprise us that they, like the ancient Greeks, knew the value of pi? Clearly, there are greater miracles available for those who wish to seek them out in the sacred texts!

But how would the ancient Hebrews to have gone about figuring out and, in particular, representing the value of pi? (Or do we really believe that one of the prophets really said, "By the way, stick that extra letter in there because God told me about pi"?)

Let's review the facts.

Unless we really want to insist that the ancient Hebrews were clumsy oxen when it came to precision in geometry -- quite a misguided perception when one considers their architectural demands -- it is clear that pi can be arrived at through meticulous measurement and comparison of diameters against circumferences.

But how would they have written the value? Again, unless we insist that the Hebrews were a bunch of inept ogres when it came to mathematics, it must be acknowledged that they would have gone about it in precisely the same way as the Greeks -- using a fraction. There was no system of decimals established yet. So how would they have represented that fraction? Using the gematric values of their alphabet, of course. And now, to top it all off, once it was discovered that the closest approximation to the value of the ratio of one-third of a circumference to its corresponding diameter was 111 over 106, what letters would they have used? Was it a miracle that they happened to pick qoph-vav and qoph-vav-he?

The answer is obvious. They would have started with 100, which is qoph. Then, for the value of 106, they would have added 6, which is vav. It didn't take a rocket scientist to see the coincidence that this spelled the word we have translated as "circumference." When it was discovered that, rather than qoph-yodh-aleph they could just as

well simply add 5 (he) to the first number to get 111, they must have been quite pleased, for all this meant was that they had to render the word for "circumference" feminine rather than leave it masculine. The mnemonic, therefore, came quite naturally to the ancient Hebrews.

Sure, the first Hebrew mathematician to discover this must have been pretty excited. But it didn't take a deity to point it out. And if you had done your research you would have known this.

Shawki Hamdan

Editor's Note:
More details can be found in:
Shlomo Edward G. Belaga : On The Rabbinical Exegesis of an Enhanced Biblical Value of Pi.
Strasbourg, Université Louis Pasteur, Institut de Recherche Mathématique Avancée,1992

Pi Art
Paintings

The remarkable numbers pi and e. I
The remarkable numbers pi and e. II
Fomenko, pp. 140 - 142

Numbering

Version of TeX:

The current version of TeX is 3.141. Every year in February DEK takes a period of two years to go over his E-mail on TeX (preprocessed by his secretary) and carries out changes if there are any. If a new version will need to be created in February it will get the version number 3.1415. Here is a quote what DEK said about the TeX versions
"You might see a pattern in these version numbers. The day I die I want someone to go into TeX and change the version to π, and then it shall not change any more."

Newsgroups: comp.text.tex
Subject: Lecture of Donal E. Knuth
From: dov@menora.weizmann.ac.il (Dov Grobgeld)
Date: Mon, 7 Dec 1992 16:18:57 GMT