Arithmetic Sequences, Diophantine Equations and the Number of the Beast

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> *Here is wisdom. Let him who has understanding calculate the number of the beast, for it is the number of a man: His number is 666.*
>
> —*Revelation 13:18 (NKJV)*

"Let him who has understanding calculate... ;" can anything be more enticing to a mathematician? The immediate question, though, is *how* do we calculate—and there are no instructions. But more to the point, just who might 666 be? We can find anything on the internet, so certainly someone tells us. A quick search reveals the answer: according to the "Gates of Hell" website (Natalie, 1998), 666 refers to... Bill Gates III!

In the calculation offered by the website, each letter in the name is replaced by its ASCII character code:

B	I	L	L	G	A	T	E	S	I	I	I	
66	73	76	76	71	65	84	69	83	1	1	1	= 666

(Notice, however, that an exception is made for the suffix III, where the value of the suffix is given as 3.)

The big question is this: how legitimate is the calculation? To answer this question, we need to know several things:

- Can this same type of calculation be performed on other names?
- What mathematics is behind such calculations?
- Have other types of calculations been used to propose a candidate for 666?
- What type of calculation did John have in mind?

Calculations

To answer the first two questions, we need to understand the ASCII character code. The ASCII character code replaces characters with numbers in order to have a numeric way of storing all characters. Capital letters are represented as follows:

A	B	C	$\cdots$	Z
65	66	67		90

This is, of course, an arithmetic sequence with first term 65 and common difference 1. But why use upper-case letters? ASCII lowercase is also an arithmetic sequence, with first term 97 and common difference 1.

That leads back to a modification of our first question: can other names be turned into 666 using these or other arithmetic progressions?

Definition 1 *A name is* beastable *if there exists an arithmetic sequence giving the name a replacement value of 666.*

Let's use an example to illustrate the procedure of determining whether or not a name is beastable. We'll begin with the name Barack Obama.

To determine whether or not Barack Obama is beastable, we seek a and d for an arithmetic sequence yielding a replacement value of 666. We use the further assumption that the replacement rule uses the alphabet in the standard order, giving the following replacement rule:

A	B	C	D	E	F	G
a	$a+d$	$a+2d$	$a+3d$	$a+4d$	$a+5d$	$a+6d$

H	I	J	K	L	M	N
$a+7d$	$a+8d$	$a+9d$	$a+10d$	$a+11d$	$a+12d$	$a+13d$

O	P	Q	R	S	T
$a+14d$	$a+15d$	$a+16d$	$a+17d$	$a+18d$	$a+19d$

U	V	W	X	Y	Z
$a+20d$	$a+21d$	$a+22d$	$a+23d$	$a+24d$	$a+25d$

Performing the calculation for Barack Obama yields

B	A	R	A	C	K
$a+d$	a	$a+17d$	a	$a+2d$	$a+10d$

O	B	A	M	A
$a+14$	$a+d$	a	$a+12d$	a

Add the values and we obtain a sum of $11a + 57d$. But notice the source of the coefficients: 11 is the number of letters in the name and 57 is the sum using $A = 0$, $B = 1$, $C = 2, \ldots, Z = 25$. The process is therefore simplified as follows:

Step 1. Replacement Rule:

A	B	C	D	E	F	G	H	I	J	K	L	M
0	1	2	3	4	5	6	7	8	9	10	11	12

N	O	P	Q	R	S	T	U	V	W	X	Y	Z
13	14	15	16	17	18	19	20	21	22	23	24	25

Calculate the replacement value (the *letter sum*) s.

Step 2. Count the number of letters (the *string length*) n.

Step 3. Form the expression $n \cdot a + s \cdot d$.

But we want our expression to be equal to 666; we therefore have

Step 3 revised. Solve the equation $n \cdot a + s \cdot d = 666$ for integers a and d.

In other words, we have a linear Diophantine equation to solve. Must a solution exist? Any elementary number theory textbook (c.f. (Burton, 2002)) will give the conditions under which such an equation has a solution:

Theorem 1 *The linear Diophantine equation $na + sd = k$ has a solution in the unknowns a and d if and only if $g|k$, where $g = \gcd(n, s)$.*

For us, $k = 666$, n is the string length and s is the letter sum. The theorem therefore translates as

Theorem 2 *A name is beastable if and only if gcd(letter sum, string length)|666.*

But what numbers divide 666? Since $666 = 2 \cdot 3^2 \cdot 37$, the factors of 666 are 1, 2, 3, 6, 9, 18, 37, 74, 111, 222, 333, and 666, yielding the following corollary:

Theorem 3 *A name is beastable if and only if gcd(letter sum, string length) is in the list 1, 2, 3, 6, 9, 18, 37, 74, 111, 222, 333, 666.*

Since names are rarely 37 letters long, the only practical values to remember are 1, 2, 3, 6, 9 and 18, the factors of 18. Barack Obama's values from before are $s = 57$, $n = 11$. Since $\gcd(57, 11) = 1$ and 1 is on the list — beastable!

We shall finish solving for a and d shortly, but first another example.

J	O	H	N		M	C	C	A	I	N
9	14	7	13		12	2	2	0	8	13

Sum the values and we obtain the letter sum $s = 80$. The string length is $n = 10$. Then $\gcd(80, 10) = 10$ and 10 is not on the list — not beastable! (Note: Sarah Palin is beastable and Joe Biden is not, so there was one on each ticket.)

Back to Barack. We know that the name is beastable, but we do not know the values of a and d that make it beastable. The key lies in using the Euclidean Algorithm and its reverse to write gcd(letter sum, string length) as a linear combination of the letter sum and the string length. For

Barack Obama, the forward steps are $57 = 5 \cdot 11 + 2$ and $11 = 5 \cdot 2 + 1$, yielding the backward steps of

$$1 = 11 - 5 \cdot 2 = 11 - 5(57 - 5 \cdot 11) = -5 \cdot 57 + 26 \cdot 11.$$

So what good does that do us? We want

$$11a + 57d = 666,$$

and we have

$$11(26) + 57(-5) = 1.$$

The next step is obvious; we mulitiply the last equation through by 666(!) We obtain

$$11(26 \cdot 666) + 57(-5 \cdot 666) = 666$$

Hence $a = 26 \cdot 666 = 17316$, $d = -5 \cdot 666 = -3330$ will work. That's an ugly solution, but it works.

We can obtain a nicer solution with a little more work:

Theorem 4 (Burton, 2002) *If a_0, d_0 is any solution to $na + sd = k$, then all other solutions are given by*

$$a = a_0 + (s/g)t, \quad d = d_0 - (n/g)t,$$

where $g = \gcd(n, s)$ and t is an arbitrary integer.

A judicious choice of t can make the solution look much nicer. The trick to a nice solution is to get the smallest possible positive value for d. The arithmetic is simple: using $d_0 = -3330$, $n = 11$, and $g = 1$, we calculate $3330/11 = 302.7$ and use $t = -303$. Then

$$d = d_0 - (n/g)t = -3330 - 11(-303) = 3$$

and

$$a = a_0 + (s/g)t = 17316 + (57/1)(-303) = 45$$

is a nice solution for beasting Barack Obama.

Of course, this can all be programmed rather easily in Mathematica. The code, complete with the output for beasting George W. Bush, is below:

```
name="george w bush"

george w bush

lettersum = StringCount[name, "b"]*1 + StringCount[name, "c"]*2 +
StringCount[name, "d"]*3 + StringCount[name, "e"]*4 +
```

```
StringCount[name, "f"]*5 + StringCount[name, "g"]*6 +
StringCount[name, "h"]*7 + StringCount[name, "i"]*8 +
StringCount[name, "j"]*9 + StringCount[name, "k"]*10 +
StringCount[name, "l"]*11 + StringCount[name, "m"]*12 +
StringCount[name, "n"]*13 + StringCount[name, "o"]*14 +
StringCount[name, "p"]*15 + StringCount[name, "q"]*16 +
StringCount[name, "r"]*17 + StringCount[name, "s"]*18 +
StringCount[name, "t"]*19 + StringCount[name, "u"]*20 +
StringCount[name, "v"]*21 + StringCount[name, "w"]*22 +
StringCount[name, "x"]*23 + StringCount[name, "y"]*24 +
StringCount[name, "z"]*25
119
numletters = StringLength[name] - StringCount[name, " "]
11
GCD[lettersum, numletters]
1
FindInstance[numletters*a + lettersum*diff == 666, a, diff, Integers]
a->-26,diff->8
```

Using the above code to "beast" names makes it apparent that the vast majority of names are beastable. In fact, the only names of well-known individuals that I have run across that are not beastable are John McCain, Joe Biden and Tiger Woods.

Historical Attempts

Two of our original questions are left, namely

- Have other types of calculations been used to propose a candidate for 666?
- What type of calculation did John have in mind?

Let's turn our attention to other types of calculations of 666. There is likely only one type of candidate more popularly-mentioned for 666 than presidents. Below is Michael Stifel's calculation for beasing Pope Leo X (Tatlow, 1991):

- Step 1. Rewrite Leo X in Latin: `LEO DECIMVS`
- Step 2. Throw out the non-numeric letters E, O, S:
  `L D CIMV`

- Step 3: Rearrange: `MDCLVI`
- Step 4: Add back in the X (either from Leo X or from the number of characters in Leo Decimus): `MDCLXVI`
- Step 5: Remove M, the initial in mysterium (Latin for religious mystery): `DCLXVI`

That's 666! Convinced?

So, who was Michael Stifel? Born in 1487 in Esslingen, Germany, he was a mathematician at the University of Könisgsberg and later at the University of Jena. Stifel invented logarithms independently of Napier (using a different approach) and is also of note for his *Arithmetica Integra* (1544), which contained binomial coefficients and the notations +, -, and $\surd$. Stifel notoriously predicted the world would end October 19, 1533 at 8:00 a.m.; he was taken into protective custody that day at 8:30 a.m.

Michael Stifel wasn't the only one who made such claims. John Napier, in "A Plaine Discovery of the Whole Revelation of St. John" (1593), claimed his calculations proved that Pope Clement VIII was the antichrist. In the same text, Napier also predicted the end of the world, in either 1688 or 1700 (at least Napier was smart enough to choose a date beyond the end of his lifetime!). Interestingly enough, Napier considered that book to be his greatest achievement. So the next time a mathematician tells you the date of the end of the world, ask if he independently discovered logarithms when he was a child. If so, let me know!

This leaves us with one last question—what might John have been thinking? The Greek text of Revelation 13:18 writes 666 this way: $\chi\xi$ϛ$'$. There were no Greek numerals; letters were used followed by $'$, which indicated a number instead of a word. Letters were given values, but not as an arithmetic sequence. The code used, the Greek gematria, is as follows:

α	β	γ	δ	ϵ	ϛ	ζ	η	θ
1	2	3	4	5	6	7	8	9
ι	κ	λ	μ	ν	ξ	o	π	ϟ
10	20	30	40	50	60	70	80	90
ρ	σ	τ	υ	ϕ	χ	ψ	ω	ϡ
100	200	300	400	500	600	700	800	900

Since Greek uses 24 characters and 27 were needed for this scheme, note the use of the archaic letters stigma for 6, qoppa for 90, and sampi for 900.

The use of the Greek gematria for calculating 666 is also well known. Therefore we can once again consult the internet to determine who might be beastable using this method. According to Walter R. Dolen (Dolen, 1998), the answer is... William J. Clinton! A quick look at his calculation, though, will reveal that he cheated, using 0 for the value of α (the "a" in William).

Keeping with the theme of presidents and popes, here is Martin Luther's calculation:

$$\begin{array}{cccccccccccc} \beta & \epsilon & \nu & \epsilon & \delta & \iota & \kappa & \tau & o & \sigma & & \\ 2 & 5 & 50 & 5 & 4 & 10 & 20 & 300 & 70 & 200 & = 666 \end{array}$$

Luther concluded that 666 may refer to a pope named Benedict or to a Benedictine monk.

A more interesting calculation is due to Ethelbert Stauffer (1902–1979), a German theologian. He used the following abbreviation of the Greek version of the official title of the Emperor Domitian, taken from coins in use at the time:

$$\begin{array}{cccccccccccccccc} \alpha & \kappa & \alpha & \iota & \delta & o & \mu & \epsilon & \tau & \sigma & \epsilon & \beta & \gamma & \epsilon & \\ 1 & 20 & 1 & 10 & 4 & 70 & 40 & 5 & 300 & 200 & 5 & 2 & 3 & 5 & = 666 \end{array}$$

Domitian was the Roman emperor when John wrote Revelation, and was in fact responsible for John being exiled to the island of Patmos where the book was written. According to Stauffer, there is additional evidence from Revelation that points to Domitian as 666. If this troubles the reader, recall that there are many instances of biblical prophecies, especially from the old testament, that have both an immediate fulfillment and a future fulfillment.

Conclusion

So what can we conclude from all this? First, most names can be beasted by using arithmetic sequences; such sequences are therefore absolutely useless in determining 666. Secondly, since the Greek gematria was the standard encoding of letters to numbers in the language John used, almost assuredly its use is the method meant by John. But since many names can also be beasted using the Greek gematria, we should be cautious about drawing conclusions based on the calculation itself without supporting evidence, such as conforming to other characteristics mentioned in scripture.

Finally, I should include a warning: The information you have learned in this article is dangerous. Do not use the methods contained herein to "beast" any member of the ACMS community or other individuals you know with an arithmetic sequence. What you may enjoy as a practical joke may not be taken as a joke by others who are unaware of the ubiquitous nature of such calculations. It is especially a good idea not to beast the name of your college's president, send the calculations to the provost, and ask for the calculations to be sent to all faculty. Trust me.

Bibliography

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