Subject: New Dice
Posted by Magic on Sun, 31 Oct 2010 15:26:44 GMT
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Hi all,

As discuss in the topic "Designing dice for dice snobs", I designed today a new Average D6 where you have to make the average of 4 faces of an octahedron, to find the result of a regular D6.

The faces of the octahedron are numbered 1, 1, 1, 1, 2, 4, 8, and 10.
Here are the operations :
(1 + 1 + 1 +  1)/4 =  4/4 = 1
(1 + 1 + 2 + 4)/4 = 8/4 = 2
(1 + 1 + 2 + 8)/4 =12/4 = 3
(1 + 1 + 4 +10)/4 =16/4 = 4
(1 + 1 + 8 +10)/4 =20/4 = 5
(2 + 4 + 8 +10)/4 =24/4 = 6

The positions of the virtual 1, 2, 3, 4, 5 and 6 are the regular positions of a D6 (opposite sides sum to 7).
This die is 21.5 x 21.5 x 21.5 mm. The diameter of the wire of the frame is 3 mm so you can print it in Stainless Steel. The price will be less than $25.

It has not been prototyped yet (as soon as I will do, it will be in the "It arrived" section).

More informations soon about other variations of this design.

[EDIT]
if you choose 1, 1, 1, 1 for the four upper faces of the octahedon, you still have several choices for the lower faces (all numbers being larger or equal to 1):
- 1, 5, 9, 9 (all numbers are in the form 4k+1, but I did not choose this one because 1 is repeated again and 9 appears twice)
- 2, 4, 10, 8 (opposite numbers sum to 12, the one I chosed)
- 3, 3, 11, 7 (all numbers are in the form 4k+3 unlike the four 1 of the opposite faces, I did not chose this one also because 3 appears twice)
- 4, 2, 12, 6 (I prefered the other one because the maximum number is smaller)
- 5, 1, 13, 5 (all numbers are in the form 4k+1, I did not choose this one because 1 is repeated again and 5 appears twice)

## File Attachments

1) Avg_both.jpg, downloaded 672 times

Subject: Re: New Dice
Posted by Magic on Sun, 31 Oct 2010 15:56:58 GMT
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And here is the first variation: the 4-Letter Words Die.
The same design but with letters instead of numbers.
The goal this time is to use the four letters of the upper faces of the octahedron to form a word.

I spent some time to find nice combinations. Probably there are better results, but on my side, with the letters I used, I got this words:
- MAIL / LIMA / MALI
- LION / LOIN
- COLA / COAL
- MACE / CAME
- CONE / NOCE
- MINE / MIEN

I choose those words, not only because they have anagrams, but also because they make sense in English and in French (at least one by line).

Here is the scheme of the positions of the letters (one letter at each corner of a cube):
I . . L
. N O .
. E C .
M . . A

And here are some not as good (according to me) solutions:
E . . N | S . . T
. L I . | . L A .
. S P . | . E R .
O . . T | O . . M

Can you find better solutions?
Perhaps by allowing W = M, U = C and N = Z?

## File Attachments

1) Letter_both.jpg, downloaded 475 times

Subject: Re: New Dice
Posted by Magic on Mon, 01 Nov 2010 22:33:47 GMT

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Wow... I've seen that someone ordered my dice before I had the opportunity to do so! Thanks!

I was actually busy with the next member of the average family: the Average D8.

It's a cube inserted inside a framed octahedron.
This time, you have to make the average of 3 faces of the inner cube (sharing a common vertex pointing upside) to find the result of the D8.

The face of the inner cube are numbered 1, 1, 1, 4, 7 and 13. The solution is unique (as far as I can see).

The calculations are:
(1 + 1 + 1)/3 = 3/3 = 1
(1 + 1 + 4)/3 = 6/3 = 2
(1 + 1 + 7)/3 = 9/3 = 3
(1 + 4 + 7)/3 =12/3 = 4
(1 + 1 +13)/3 =15/3 = 5
(1 + 4 +13)/3 =18/3 = 6
(1 + 7 +13)/3 =21/3 = 7
(4 + 7 +13)/3 =24/3 = 8

The position of the results from 1 to 8 are nearly those of one of my standard D8, only the 7 and the 5 (and their opposite faces) being swapped.
Anyway, I am unsure there is a real logic in the D8 numbering (except opposite faces sum to 9), so this one - which has an underlying explanation - could be adopted.

Concerning the Average D20 and most of all for the Average D12, the calculations will be far more complex, so do not expect them too soon.
There are perhaps more chance to see the 5-letter words D12...

## File Attachments

1) AverageD8.jpg, downloaded 566 times

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Subject: Re: New Dice
Posted by Magic on Wed, 03 Nov 2010 07:03:57 GMT
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Hi again,

I would like to introduce an unexpected member of the Average Dice family: the Average D4.

But before that I would like to share how I constructed it, so sorry for the long post (and for those bored by pseudo-mathematical explanations, just skip to the picture )

/* begin mathematical blabla */
I knew it was impossible to follow exactly the same rules to make an average D4, because if the result 1 is made by averaging 1s then 3 faces out of 4 should have been numbered 1 and only one face was remaining. This would have given the expected 1 and 3 times another result.
But by bending the rules, by allowing 0 or even negative numbers, I was convinced I could reach the goal of having 4 numbers that taken 3 by 3 could average to 1, 2, 3 and 4.
I tryed using 0, then -1 and also -2, but arrived nowhere.

So to start with something, I took a D4 numbered for 1 to 4 and I summed the faces sharing one vertex
1+2+3=6
1+2+4=7
1+3+4=8
2+3+4=9
The interesting thing was that those results were following each other: 6, 7, 8, 9. But I had to substract 5 to those results to obtain was I wanted.
I could not lower the face numbers by 1 (these would have lowered the result by only 3). To achieve the result I have to substract from the initial a fractional number: 5/3
1 - (5/3)=-2/3
2 - (5/3)= 1/3
3 - (5/3)= 4/3
4 - (5/3)= 7/3
By replacing 1 by -2/3 2 by 1/3 etc... I could obtain by summing 1, 2, 3, 4. But as it is not a summing die, but an average die, I precisely had to multiply these number by 3 since the average is made by summing 3 numbers and then dividing them by 3.
That's how the numbers -2, 1, 4 and 7 appeared to me.
/* end mathematical blabla */
So, here it is:

No need to add any frame: when lying on a flat surface, the tetrahdron has already a vertex pointing upward.
So you just have to sum the numbers of the 3 visible faces.
As said earlier, these numbers are -2, 1, 4 and 7.

The operations you have to do are:
(-2+1+4)/3 = 3/3 = 1

(-2+1+7)/3 = 6/3 = 2
(-2+4+7)/3 = 9/3 = 3
( 1+4+7)/3 =12/3 = 4

Are there other solutions for numbering the faces?

[EDIT: fixed some wrong maths]

## File Attachments

1) AverageD4.jpg, downloaded 533 times

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Subject: Re: New Dice
Posted by Youknowwho4eva on Wed, 03 Nov 2010 12:55:05 GMT
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Stop with the math already . Your last two solutions you have 3/3 = 3 and 3/3 = 4.

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Subject: Re: New Dice
Posted by Magic on Wed, 03 Nov 2010 13:11:06 GMT
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Oh. So, someone read it
I am going to fix that! Thanks!

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Subject: Re: New Dice
Posted by Youknowwho4eva on Wed, 03 Nov 2010 13:17:52 GMT
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Yea I read it lol. I don't know why it caught my eye but it did. I like the Outside the box thinking of these.

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Subject: Re: New Dice
Posted by gibell on Wed, 03 Nov 2010 13:40:00 GMT
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Interesting stuff! But what about the icosahedron / dodecahedron?? Have you gotten that to work

out??

Subject: Re: New Dice
Posted by Magic on Wed, 03 Nov 2010 19:52:51 GMT
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@gibell Ahah! Is that a challenge?
I am currently working on Average D20 and Average D12.
On Average D20, I can already tell you that the numbers on the 12 faces of the internal dodecahedron will be multiples of 3 plus 1 (numbers like 1, 4, 7, 10, 13, 16, 19...) and the 12 of them will sum up to 126.

And BTW, for Average D4 the solution is unique, and can be found just resolving a system of equations.

[EDIT] the sum must be 126, that is 210 (the sum of the numbers from 1 to 20) multplied by 3 (the number of faces joining into a vertex) divided by 5 (the number of vertices by face).

Subject: Re: New Dice
Posted by Magic on Sat, 06 Nov 2010 21:47:11 GMT
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I tried to found manually the solutions for the average D20, but each time I thought I got the solution, I was missing it by one number (for instance, all the numbers between 1 and 20 were present except for 17 that was replaced by 22!).

So I decided to use my computer to enumerate part of the combinations, and I found 5 distinct solutions.
3 solutions use the numbers 1-1-1-4-4-7-10-13-16-22-22-25 in the internal dodecahedron's faces, 1 solution the numbers 1-1-1-4-4-10-13-16-16-19-19-22 and the last one the numbers 1-1-1-4-7-7-13-13-19-19-19-22.

I think I will use the last one because there are three 19s at one vertex (that average to 19!) and it's a kind echo to the three 1s.

Unfortunately none of the solutions respects the property that opposite faces of the framed D20 sum to 21...

Now the D12...

Subject: Re: New Dice
Posted by dizingof on Mon, 08 Nov 2010 11:01:22 GMT
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Ask Shapeways to add a Casio FX calculator to each dice sale !!!

Subject: Re: New Dice
Posted by Magic on Wed, 17 Nov 2010 22:00:34 GMT
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The Average Dice are really interesting. So expect more messages from me in this thread!
I solved the Average D20 and the Average D12 seems much easier, but I had a problem with the design.
So I decided to use 3 "form factors" for the Average Dice

I called the one you already seen for the D6 and the D8 "Cage"
And beside it, you have the "Molecule" one and the "Hollow" one.
I will probably use the Molecule design to make the D12 and the D20 (with no need to repeat the numbers as I did for the Average D6 Molecule).
The Hollow one can be used for D6 and D8 only, I guess. The big hole at the center of each face underline the fact that there is no number where usually you can find one.

More news soon...
Stay tuned!

## File Attachments

1) AvgD6_all.jpg, downloaded 366 times

Subject: Re: New Dice
Posted by Magic on Sat, 27 Nov 2010 08:04:31 GMT
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I was working on the Average-D12, and I realized that it can be a little bit "boring", since it contains only numbers in the form 5k+1 (like 1, 6, 11, 16 etc.). So you have to sum three 6 and two 1 to obtain 20 and then divide by 5 to get the result (4).

That's why I was wondering if I could transform an Average-Die into a Sum-Die (where you would have only to sum the numbers written on the faces around a vertex, without dividing by the

number of face, which imply that the numbers will be smaller).

An obvious way to do that is to divide from the beginning all the numbers by the number of faces by vertex.
For instance, for the D6 with the numbers 1, 1, 1, 1, 2, 4, 6 and 10, if you divide by 4 you obtain 1/4, 1/4, 1/4, 1/4 1/2, 1, 3/2 and 5/2. This does not change the results that go from 1 to 6. With these fractional numbers, you obtain what we can call a fractional Sum-D6.

Another way would be to use numbers in the form 4k+1 like 1, 1, 1, 1, 1, 5, 9, 9 and replace 4k+1 by simply k that is 0, 0, 0, 0, 0, 1, 2, 2.
By summing, you obtain all the numbers from 0 to 5 (instead of 1 to 6): this is the integer Sum-D6.
You can do it with any regular Average-Die.
For instance for the Average-D4 (-2, 1, 4, 7) the transformation leads to the numbers -1, 0, 1 and 2 and taken 3 by 3 their sum gives all the numbers between 0 and 3.

This is the first step to my next post: the Double-D6!

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Subject: Double D6
Posted by Magic on Sat, 27 Nov 2010 08:53:49 GMT
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OK, after the starter, the main course!

There are several double dice but I wanted to try something new.

So I dediced to combine a "nearly" standard D6 with an integer Sum-D6 to make a Double-D6.

For the integer Sum-D6 that make the frame, I chose the number 0, 0, 0, 0, 0, 1, 1 and 3 because, for aesthetical reasons, I wanted to avoid the number 2 (impossible to place 2 pips symmetrically in a corner).

The core is a D6 that is numbered from 2 to 7, to compensate the fact that the frame goes only from 0 to 5 (instead of 1 to 6, as regular D6).

The core can roll freely inside the frame, so when you draw this die, the frame and the core both get a random orientation and the result when you sum the pips from the upper face of the core and the pips of the 4 upper corners of the frame is the same as summing 2 regular D6.

For instance, in the picture, you have 3 pips on the face and 2 extra pips in the corners thus the result is 5.

So instead of using 2 regular D6, if you do not care about individual results but only the sum, you can use this Double-D6. Same results but in a more original and stylish way!

It has not been prototyped yet so I am unsure it rolls properly. But I will order a version in Alumide soon.

## File Attachments

1) DoubleD6.jpg, downloaded 329 times

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Subject: Re: Double D6
Posted by Magic on Sun, 12 Dec 2010 17:23:00 GMT
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The D4, D6 Cage and D8 Cage arrived!

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Subject: Re: Double D6
Posted by mctrivia on Sun, 12 Dec 2010 20:44:21 GMT
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that is a really cool design.

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Subject: Re: Double D6
Posted by Magic on Sun, 12 Dec 2010 20:50:55 GMT
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Thanks Mctrivia,

D12 and D20 should follow (probably in the molecule form factor), but I am currently busy with some truncated spheres

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Subject: Re: Double D6

Posted by mctrivia on Sun, 12 Dec 2010 22:11:56 GMT
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i would print a test before you waist time designing them.  I will definitely be buying at least 1 if this will pass chi square test but i suspect it will not.  Not because your math is off your theory is sound.  Just suspect the last state the die was in will add a biais to the next state.

That said I am sure some will buy if fair or not.  but if you test you may be able to figure out how to improve and make both fair and beautiful.