MULTIPLE ANAGRAMS

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The following is suggested as a method of evaluating anagrams, and a tentative "yardstick" is shown in Figure 1.

An anagram, being a rearrangement of all the letters in a word, is clearly one out of a number of permutations. The total number of permutations of \( N \) letters equals \( N! \) (which is not an expression of surprise, but means factorial \( N \): \( N! = 1 \times 2 \times 3 \times \ldots \times N \)). For example, \( 1! = 1 \), \( 2! = 2 \), \( 3! = 6 \) and \( 4! = 24 \). Increase of \( N \) creates a rapid increase of \( N! \) -- in fact, at \( N = 10 \), we find that \( 10! = 3,628,800 \).

Given any five-letter word, for instance, we know there are 120 possible permutations of the letters. But how many of the 120 permutations are valid? A six-letter word has 720 permutations -- how many of them are valid?

If we symbolize the valid words as \( V \), and the totality of possibilities as \( P \), then \( V/P \) equals the measure of our success. In the case of one-letter words, there is no difficulty, and the question is trivial. We use, commonly, only \( I \) and \( A \), both of which permute into themselves; \( V/P = 1/1 = 1 \). With two-letter words such as \( EM \) and \( ON \), we have two permutations for each, both of which are valid; \( V/P = 2/2 = 1 \) once more.

Three-letter words are arrangeable in six permutations (\( abc \), \( acb \), \( bac \), \( bca \), \( cab \), \( cba \)). The word \( TEA \) yields, anagrammatically, \( ATE \), \( EAT \) and \( ETA \); therefore \( V/P = 4/6 \), or 0.67. Four-letter words have 24 permutations. \( VEIL \) may be rearranged into \( LEVI \), \( VILE \), \( LIVE \), \( EVIL \) and \( IVEL \); here, \( V/P = 6/24 = 0.25 \). Five-letter words have 120 permutations. \( STEAK \) gives \( TEAKS \), \( SKATE \), \( KATES \), \( STAKE \), \( TAKES \) and \( KEATS \) as anagrams, and \( V/P = 7/120 \), or 0.05. Six-letter words yield 720 permutations. \( ULSTER \) rearranges itself into \( LUSTRE \), \( LUSTER \), \( RUSTLE \), \( RESULT \) and \( SUTLER \), which gives a score \( V/P \) of \( 6/720 \), or 0.008. We have not pursued this research beyond \( N \) equal to six.
Tabulating the above findings, we have:

<table>
<thead>
<tr>
<th>N</th>
<th>P</th>
<th>V</th>
<th>V/P</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1.00</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1.00</td>
</tr>
<tr>
<td>3</td>
<td>6</td>
<td>4</td>
<td>.67</td>
</tr>
<tr>
<td>4</td>
<td>24</td>
<td>6</td>
<td>.25</td>
</tr>
<tr>
<td>5</td>
<td>120</td>
<td>7</td>
<td>.05</td>
</tr>
<tr>
<td>6</td>
<td>720</td>
<td>6</td>
<td>.008</td>
</tr>
</tbody>
</table>

and if we graph this data, setting N-values on the x-axis, and V-values on the y-axis, the dashed line of Figure 1 results.

It is of interest, perhaps, that the above bears a certain resemblance to the famous Witch of Agnesi curve which has applications in probability problems. (Shall we name our graph The Curve of Anagram-
matic Success?) Just what happens to the curve when \( N \) is greater than 6 is uncertain to us, but in view of the rapidly-increasing denominator of \( V/P \), the fraction must diminish rapidly, and the curve fall steeply. In fact, it is quite possible that few valid anagrams may be found in longer words, and the curve will tend toward zero.

We were quite pleased with our graph, the dashed line in the figure labeled "Amateur". Then we showed it to a friend who quickly advanced it both upwards and outward. His improvement is shown as a solid line in the same figure, and is labeled "Expert". Both of these graphs end in question-marks because research has not been extended beyond seven-letter words. The cross-hatched area to the North and East of the Amateur and Expert graphs is an indeterminate zone rather than a definite line. It is the area of the "Master".

Expertise in these categories of Amateur, Expert and Master would seem to hinge on three things: Reference Books, and the latitude they give; Diligence; and Time. Take away or diminish any one of these factors and the curve drops. Books are no help without Diligence, or Time to use them. Diligence without Books will be defeated. Time without the other two factors (or either one of them) will be unavailing. As Diligence and Time are rather subjective and vary with the individual, let us consider the Reference Books only. They are concrete and objective -- you either have them, or you don't.

Your Amateur, a part-time but enthusiastic logophile, will probably not have an extensive library of reference books from which to draw needed knowledge. He may have a Webster's New Collegiate (if his daughter has not taken it off to college with her), or a small Vest-Pocket Dictionary. Nonetheless, great things can be accomplished with these. He will occasionally consult them on Crossword Puzzles and Anagrams -- recreations which he enjoys for the most part on Sundays. Weekdays must be devoted to more mundane pursuits; but he will sometimes sneak in a word or so over his breakfast coffee ... 

The Expert's library is fuller and he will use it often. His dictionaries are thicker and he will certainly have a Webster's Unabridged or an Oxford Universal -- and surely a good Atlas. With Diligence and Books his Curve of Anagrammatic Success will soar above that of the Amateur. He is a weekday as well as a Sunday anagrammatist, and his breakfast coffee may last a long time ... 

The Master operates in a cloud-land where participants are as
rare as reference books are dense. He is suspected of using a computer to give him all the possible letter-arrangements of a word, and of testing each one, carefully, for its validity. But what may be valid to him is far beyond the scope of the Amateur and the Expert, for his library is replete with Dictionaries of all kinds, English and exotic; Atlases, Gazetteers, Who's Whos, Encyclopaedias, Histories, etc. This superman of the language field thinks nothing of donning his magic cloak and zooming off to the Bodleian Library to examine the glaze of an early Anglo-Saxon MS ...

We were pleased, yes, with our six valid possibilities of ULSTER. Then, LUTERS sprang to the eye and was found in the august body of Oxford Universal. This gave pause. If LUTERS, perhaps STRULE would show up in another reference book? Mr. Dmitri Borgmann, whose books show that almost anything may happen, logologically speaking, and very often does, records seven transformations of the seven-letter DECIMAL, and as many as sixteen of the nine-letter AEGINRST -- but don't expect to find them all in a Vest-Pocket Dictionary!

Perhaps, to keep this a recreational game, one should limit himself to the category proscribed by his library. There is plenty to be explored, and it is hoped that interested readers will take pleasure in the search for higher graphs.

COMMENT (Darryl H. Francis): Mr. McClellan's interesting article is closely related to some work I did during the summer of 1969. It isn't hard to find three different letters which can be rearranged to form six valid words. For example, the letters A, E and R give the six words AER, ARE, EAR, ERA, RAE and REA, all of which can be found in the Second Edition of Webster's Unabridged Dictionary. Other letters giving six valid words are A, E and S (ESA is a river in Somaliland, given in the Times Index-Gazetteer of the World, and EAS is the plural of ea) and A, E and N (ENA is a girl's name, given in the Random House Dictionary). I am sure that there are other groups of letters where all six arrangements are genuine words.

Are there any four distinct letters which yield 24 valid words? I doubt it. The nearest I have been able to get is with the letters A, E, L and S. The words ALES, ASEL, ELAS, LEAS, SALE, SEAL, SELA, SLAE and SLAE are all in Webster's Second Edition, and LASE can be found in the Addenda of Webster's Third Edition. In addition to these ten, there are the two place-names LESA (a place in Italy) and ESLA (a river in Spain) which can be found in the previously-mentioned Times gazetteer. A thirteenth word can be added if we can accept ETAL in the Etymology section.

The five words from the Index-Gazetteer of the World are:

LAES,
LAS,
ALE,
AST,
AEL

These 31 words, in which ETAL is allowed in the Index-Gazetteer of the World, are themselves to be added to ETAL in the comments.

Can any of these results be added to the list?
be added if we allow ourselves to pluralize proper names. ELA is listed by Webster’s Second Edition as a Biblical name. Therefore we can come up with ELAS, persons or towns such as ELA.

The five letters A, E, L, S and T yield a large number of valid words from several different sources:

LAETS, TALES, TEALS, TAILS, STALE, SLATE, TESLA, LEAST, LEATS, LATES, ATLES, ALETS, SETAL, SLEAT and STELA (Webster’s Second and Third Editions)
ALETs (plural of verb alet), SEALT (variant of salt), TASL (variant of teasel) (Webster’s First Edition)
LAST (Funk & Wagnall’s Unabridged Dictionary, 1946)
ALET, ASTEL, ESTAL, SATLE, TASEL, LAEST, LASET, LEATS, LATES, ATLES, SALET, SETAL, SLEAT (variant of tease) (Webster’s First Edition)
LASTE (Webster’s Second and Third Editions)
ASTLE (Bartholomew’s Gazetteer of the British Isles)
AELST, ALTES, STAE (biographical names from Hyamson’s Dictionary of Universal Biography)

The 31 words can be increased to 33 if one admits place-names in which the anagrammed word is part of a phrase: the Times Index-Gazetteer lists TSELA DZON in Tibet and SELAT DIEBEL in Algeria. Two more words can be added if we again allow ourselves to pluralize proper names; the Times Index-Gazetteer lists ETAL in England and LETA in Missouri.

Can any reader find groups of four or five letters which give superior results? Can this research be extended to six letters or more?