REAL WORD SQUARES

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Real Word Squares

Here are word squares made up of 3-frag words. Taking 165,000 words of length 9 through 13, I found that 5,780 can be broken into 3 common-word fragments. They use 2,578 of the 7,100 2,3,4 and 5-letter allowed frags to produce 21 squares.

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clip per man      deep water man     hard ware man     here after ward
per cent age      water bail age     ware house age    after rip en
man age less      man age less       man age less      ward en ship

mono tele phone   per quad rat       re under cut      semi re flex
tele kine tic     quad rill ion      under eat en      re adopt ion
phone tic ally    rat ion ally       cut en ess        flex ion less

sub semi tone     sub trans verse    pick ma wing      under bed ding
semi aqua tic     trans sit man      ma laxer man      bed evil led
tone tic ally     verse man ship     wing man ship     ding led angle
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Substitutions are possible: cent=mill, kine=soma, mono=pan, aqua=drama, adopt=elect=press=quest=sect=tract.

Using words of length 9 through 12 and limiting the frag length to 4, my database identified 2,724 words which can be broken into four frags. This was not quite enough to allow the construction of a 4x4 square, so I added 47,600 words of length 8. This allowed a list of 3,082 4-frag words, and the following square.

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cob re at he
re ad he re
at he is tic
he re tic ally
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Minor substitutions: is=ma=to, ally=ate.

Bigram-Frag Squares

In this section, frags need not be words. In order to get a reasonably sized set of words to work with, I selected words of length 8 with a CVCVCVCV pattern, and took all CV bigrams as frags. Of the 47,800 words of length 8, 2,661 have the proper CV pattern. They yielded 145 squares; a few samples are on the next page.

Finding 5x5 squares using words of length 10 was difficult.

bi fo ra te	da ta ba se	he pa ti ca
fo re pa le	ta bu la re	pa lo me ta
ra pa ki vi	ba la di ne	ti me li ly
te le vi se	se re ne ly	ca ta ly ze
ka la ma lo	va po ra te	zy mo de me
la ke li ke	po ro ce le	mo no cu li
ma li ka la	ra ce mo se	de cu ma ni
lo ki la ni	te le se me	me li ni te

On the one hand, I did not want to use all bigrams from my list of 41,750 words, as I expected this would take too much computer time. On the other hand, the list contains only 1,194 words with CVCVCVCVCV patterns, far too few to make squares. Selecting words in which each of the 5 bigrams is either CV or VC allowed using 7,327. This still proved too small a group to make squares. The winnowing process that was successful required that the first, second, third and fifth bigrams be either CC, CV or VC, and that the fourth bigram be either CV or VC. This allowed using 29,060 words. With them, the computer ran for several hours and identified 611 squares with no more than one flaw in the final word. Only 2 of them were perfect.

pr om in en ce	re me di ab le
om ni te ne nt	me la st om ad
in te rm as on	di st ra in er
en ne as em ic	ab om in ab le
ce nt on ic al	le ad er le ss

The five words of length 10 in the first square are all in Web 2, but only two are listed in boldface. All five words in the second square can be found in Web 3, and four of them are in the 9th Collegiate. All the bigrams in the second square can probably be justified as words.

My attempt to find 4x4 squares by dividing words of length 12 into trigram frags wasn't successful. Of a possible 17,576 trigrams, 4,120 were found in one of the AAABBBCCCDDD positions of my 25,079 words. My computer found that there were many ways to place three words, but filling in the fourth was not possible.

Statistics

According to the standard scaling formula, the above data predict a support of $2661/145.1^{1/4} = 767$ for the 4x4 bigram frag square, and a support of $29059/2^{1/5} = 25300$ for the 5x5 bigram frag square. These are much larger than the corresponding supports for letter squares (90 to 130 for 4x4, 350 to 600 for 5x5), but one is dealing with 120 bigrams (6 vowels x 20 consonants) and approximately 550 bigrams, respectively, instead of 26 letters. Scaling these numbers down, the supports become 166 and 1196, in rough agreement with the alphabet case.