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Book 18 (1/00 - 12/00)

1. Noise syndrome + entry, etc.
4. A comment on the WLEN
6. "Typical Pain" dealing on the SEC.
8. On S-random permutations
10. Continued from p. 7.
11. An Improved Decade for Binary Numbers.

3-6-00. On  $s$ -random permutations,

Consider the sample space  $\Omega_n$  consisting of all  $n!$  permutations  $(\pi(1), \pi(2), \dots, \pi(n))$ . Let  $s \geq 1$  be a fixed integer, and suppose  $n \gg s$ . For each ordered pair  $(i, j)$  with  $1 \leq i < j \leq n$  and  $j-i \leq s$ ,

define the random variable

$$X_{(i,j)}(\pi) = \begin{cases} 1 & \text{if } |\pi(i) - \pi(j)| \leq s-1 \\ 0 & \text{if } |\pi(i) - \pi(j)| \geq s. \end{cases}$$

Then define

$$(1) \quad X_s(\pi) = \sum_{i < j \leq s} X_{(i,j)}(\pi),$$

which represents the number of violations of the " $s$ -random" condition.

For any  $(i, j)$ ,

$$\Pr\{X_{(i,j)}(\pi) = 1\} \approx \frac{2(s-1)}{n}$$

overall (ignoring end effects), there are  $2(s-1)$  forbidden

values for  $\pi(1), \pi(2), \pi(3), \dots, \pi(s-1)$ . Furthermore,  
 there are  $\approx ns$  terms in the sum (1), so

$$E(X_s) \approx 2s(s-1).$$

Assuming then that  $X_s$  is Poisson,

$$P_1(X_s=0) = e^{-2s(s-1)},$$

which is the probability of finding an  $s$ -random  
 permutation. So we have

Conjecture. Let  $P_s(n)$  be the number of  $s$ -random  
 permutations on  $n$  letters. Then

$$\lim_{n \rightarrow \infty} \frac{P_s(n)}{n!} = e^{-2s(s-1)}.$$

3-7-00

A Note on RA Codes.

Let  $A_n$  be the  $n \times n$  "accumulator" matrix:

$$A_6 = \begin{pmatrix} 1 & 1 & 1 & 1 & 1 & 1 \\ 0 & 1 & 1 & 1 & 1 & 1 \\ 0 & 0 & 1 & 1 & 1 & 1 \\ 0 & 0 & 0 & 1 & 1 & 1 \\ 0 & 0 & 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 0 & 0 & 1 \end{pmatrix}.$$

Then the "repeat-permute" portion of an RA encoder is simply multiplication by a (1,2) low-density generator matrix  $G$ :

$$G = \begin{pmatrix} 1 & 1 & & 1 & & \\ & 1 & & 1 & 1 & \\ & & & 1 & 1 & 1 \end{pmatrix}.$$

Why not replace  $G$  with a different LDGM?

$$G = \begin{pmatrix} 1 & 1 & 0 & 0 & 1 & 0 \\ 0 & 1 & 1 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 & 1 & 1 \end{pmatrix}$$

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