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PUSH-PENNY: What Is Your Expected Score?

PROBABILITY IS CONCERNED WITH predicting the results of random phenomena. An understanding of randomness and its consequences is fundamental to the study of probability. Mathematics-education researchers have given considerable attention to the subjective understanding of probability concepts. The literature contains numerous articles that relate this type of research to the teaching of probability and statistics (see Shaughnessy and Bergman [1993] for a review of this literature).

> Researchers consistently report that students' intuition about randomness, especially as it appears in independent coin tosses, is notably weak (Green 1994; Konold et al. 1993; Shaughnessy 1981). In some studies, more than half the students did not expect to see many runs as long as three heads. Many students thought that independent tosses of a fair coin should result in exactly half heads and half tails, and many of these same students concluded that every other toss should be a head. A common intuition about probability is that it is deterministic; the concept of random variation is missing.
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> Another study concluded that "drawing inferences from experiments, and knowledge of the stability of frequencies (i.e., the evening out of proportions with increasing numbers of trials), were both very weak areas. The test results, and follow-up interviews, suggest that a lot of practical activity and discussion is needed to develop an appreciation of these concepts in the majority of pupils" (Green 1983).
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> These studies support the need for appropriate activities that allow students to experience randomness to develop a proper intuition for the concepts of probability. This intuition is needed as a foundation before developing formal-reasoning skills in the mathematical analysis of probability. The learning activity discussed here is intended to develop the students' intuitive feeling for the consequences of randomness. The skills developed include data handling and the construction and use of tables and graphs.

The game of "Push-Penny" described by the Schools Council Project on Statistical Education (1980) can be played with a quarter and a lined piece of poster board. The object of the game is to push the coin and have it land on a line. Each player takes twenty pushes. A *hit* has a value of +1; a *miss* has a value of –1. The score after any push is the sum of hits (+1's) and misses (–1's). The final score is the score at the end of the game.

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