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Paper and pencil. Early calculation techniques in operations research

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This paper asks what calculation techniques operations research scientists used. Until the 1970s, most scientists at universities did not have access to computers. Even Georg Danzig, who worked at the Rand Corporation, did not calculate the so-called diet problem on an electronic digital computer until 1953. Previously, he had used an electric desktop calculator. There are also no convincing reports from Stafford Beer's OR group at United Steel in Great Britain about which problems he solved with the Ferranti computer that had been available to him since 1956. It is known that this computer was very difficult to program. To avoid difficult calculation problems, OR researchers developed certain techniques, including using paper and pencil, mental arithmetic, or desktop calculators to solve simple problems. While solutions to linear optimization problems normally require division, this is not the case with the transportation problem, as it only involves addition and subtraction. For this reason, the transportation problem was popular in textbooks and university courses. But there existed no economic problem solved in the capitalistic world that used the technique of the transportation problem. So, the transportation problem remained in the academic world. (The communist world 1950-1990 used the transportation problem). The Monte Carlo method was another way to solve problems without a computer and without empirical research. The use of random numbers in the context of the Monte Carlo method relieved OR researchers of the need to conduct their own empirical research and evaluations on the computer. Operations research was able to consolidate its position as desk-based research without computers. In order to plan the delivery van deployment of a department store, the Polish author Wieslaw Sadowski, in his OR textbook published in German in 1963, simply selected five random numbers from a published table, transformed the data into a normal distribution with a specific mean and variance, and applied it to the problem. Sadowski picked up his delivery van example from Churchman's et al. textbook: *Introduction in Operations Research* 1957, p. 411. In German-speaking countries, computer applications were long ignored in operations research textbooks and were not integrated into textbooks until the 1990s.

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