For a permutation π, the major index of π is the sum of all indices i such that $\pi_i > \pi_{i+1}$. In this thesis, we study the distribution of the major index over pattern-avoiding permutations of length n. We focus on the number $M_n^m(\Pi)$ of permutations of length n with major index m and avoiding the set of patterns Π.

First, we are able to show that for a singleton set $\Pi = \{\sigma\}$ other than some trivial cases, the values $M_n^m(\Pi)$ are monotonic in the sense that $M_n^m(\Pi) \leq M_{n+1}^m(\Pi)$. Our main result is a study of the asymptotic behaviour of $M_n^m(\Pi)$ as n goes to infinity. We prove that for every fixed m, Π and n large enough, $M_n^m(\Pi)$ is equal to a polynomial in n and moreover, we are able to determine the degrees of these polynomials for many sets of patterns.