An Extension of Our Bound on the Number of Absolutely Irreducible Factors of a Multivariate Polynomials

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We have given a bound on the number of absolutely irreducible factors of a multivariate polynomial over a finite field when the leading form is square-free. Here we present an extension of this result, when the leading form is of the type $f(\mathbf{X}) = A(\mathbf{X})^2 B(\mathbf{X})$, where $A(\mathbf{X})$ and $B(\mathbf{X})$ are square-free and relatively prime. As a consequence, we will show that all generalized binomials $f(X) + g(X)$ of the said type, with $B = 1$, are either absolutely irreducible or the square of an absolutely irreducible generalized binomial over the same defining field. Finally, we will discuss an application to exceptional permutation polynomials over finite fields.