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# Formula for primes, twinprimes, number of primes and number of twinprimes

A VENUGOPALAN

Sree Vidya, 5/1153, VH Road, Calicut 673 001, India

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**Abstract.** Formulae for computing the $n$th prime, twinprime, the number of primes smaller than a given integer, and the number of twinprimes smaller than a given integer are presented. Proofs for the development are also furnished.

**Keywords.** Primes; twinprimes

## 1. Introduction

Let $p_1 = 2$, $p_2 = 3$, $p_3 = 5, \ldots, p_n$ be the sequence of the first $n$ primes, and,

$$Q = \prod_{i=1}^{n} p_i \tag{1}$$

This paper presents formula to compute the $(n+1)$th prime which is $p_{n+1}$ and other allied results.

Let

$$Q_i = Q/p_i, \quad \text{for} \quad i = 1, 2, 3, \ldots, n \tag{2}$$

$1 \leqslant a_i \leqslant (p_i - 1)$

$$K = n - \sum_{1}^{n} (1/p_i) \tag{3}$$

$0 \leqslant b \leqslant [K]$, where $[K]$ denotes the integral part of $K$ and

$$J = \sum_{1}^{n} a_i Q_i - bQ \tag{4}$$

The following four theorems are first proved.

THEOREM 1.

For $n$ greater than 1,

$$\sum_{a_1=1}^{(p_1-1)} \cdots \sum_{a_n=1}^{(p_n-1)} \sum_{0 \leqslant b \leqslant [K]} X^J = X + (1/X) + f(X) + f(1/X) \tag{5}$$

where $f(X) = \sum a_m X^m$

$$1 < m \leqslant [K] Q \prod_{i=1}^{n} (1 - (1/p_i)), \ (m, Q) = 1, \text{ and}$$

$a_m = 1$ for all $m < Q$ and $(m, Q) = 1$ and $a_m = 0$ for some $m \geqslant Q$.