A NOTE ABOUT THE DERIVATIVES OF LEGENDRE POLYNOMIALS

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Here is an alternative, shorter, proof of the result proved by Grosswald.¹

We have

\[(1 - 2xp + x^2)^{-1/2} = \sum_{0}^{\infty} P_n(x)x^n.\]

Differentiating \(r\) times with respect to \(x\) and putting \(x = 1\), we have

\[1 \cdot 3 \cdot 5 \ldots (2r - 1)x^r(1 - x)^{2r-1} = \sum_{0}^{\infty} P_n^{(r)}(1)x^n.\]

Equating coefficients of \(x^n\) we now have

\[P_n^{(r)}(1) = \frac{(n + r)!}{2^r(n - r)!}.\]

Similarly, we may show that

\[P_n^{(r)}(-1) = (-1)^{n+r} \frac{(n + r)!}{2^r(n - r)!}.\]

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