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Some Inversion Formulas for Sums of Quotients

by Natalio H. Guersenzvaig and Michael Z. Spivey

In this note the authors establish some formulas for certain sums of quotients of a positive integer \( n \), which are closely related to an identity established by Prévile-Ratelle in Problem M40 of the April 2003 issue of CRUX with MAYHEM. They also establish some elementary facts that are not well known about quotients and remainders.

Their main result is the following theorem.

**Theorem.** Let \( n \) and \( k \) be any positive integers with \( k \leq n \). Then

\[
\sum_{d=1}^{k} \left\lfloor \frac{n}{d} \right\rfloor - \sum_{d=\lceil \frac{n}{k} \rceil + 1}^{n} \left\lfloor \frac{n}{d} \right\rfloor = k \left\lfloor \frac{n}{k} \right\rfloor.
\]

Enjoy!

Problems: 3056, 3101–3113

This month’s “free sample” is:

**3101.** Proposed by K.R.S. Sastry, Bangalore, India.

The two distinct cevians \( AP \) and \( AQ \) of \( \triangle ABC \) satisfy the equation \( AQ^2 = AP^2 + |AC - AB|^2 \).

(a) If \( BP = CQ \), show that \( AP \) bisects \( \angle BAC \).

(b)★ If \( AP \) bisects \( \angle BAC \), prove or disprove that \( BP = CQ \).

**3101.** Proposé par K.R.S. Sastry, Bangalore, Inde.

Les deux cévaines distinctes \( AP \) et \( AQ \) d'un triangle \( ABC \) satisfont l'équation \( AQ^2 = AP^2 + |AC - AB|^2 \).

(a) Si \( BP = CQ \), montrer que \( AP \) est une bissectrice de l'angle \( BAC \).

(b)★ Si \( AP \) est une bissectrice de l'angle \( BAC \), démontrer ou réfuter l'égalité \( BP = CQ \).

Solutions: 2923, 2984, 3001–3007