Verifying differential equations satisfied by Jacobi elliptic functions am, sn, cn, dn for $k > .1$ Assuming $m = k^2$, $k > 1$ From the definition:

$$\mathrm{sn}(u, m) = \frac{1}{k}\mathrm{sn}(ku, 1/m),$$

with $1/m < 1$. We also know that

$$\mathrm{cn}(u, m) = \mathrm{dn}(ku, 1/m),$$

$$\mathrm{dn}(u, m) = \mathrm{cn}(ku, 1/m).$$

Thus

$$\mathrm{sn}'(u, m) = \frac{1}{k}k\,\mathrm{sn}'(ku, 1/m) = \mathrm{cn}(ku, 1/m)\,\mathrm{dn}(ku, 1/m) = \mathrm{dn}(u, m)\,\mathrm{cn}(u, m).$$

$$\begin{aligned}\mathrm{cn}'(u, m) &= k\,\mathrm{dn}'(ku, 1/m) = k(-(1/m)\,\mathrm{sn}(ku, 1/m)\mathrm{cn}(ku, 1/m) \\ &= -(1/k)\mathrm{sn}(u, 1/m)\mathrm{cn}(ku, 1/m) = -\mathrm{sn}(u, m)\mathrm{cn}(u, m),\end{aligned}$$

$$\begin{aligned}\mathrm{dn}'(u, m) &= k\,\mathrm{cn}'(ku, 1/m) = -k\mathrm{sn}(ku, 1/m)\mathrm{dn}(ku, 1/m) \\ &= -(1/k)\mathrm{sn}(u, 1/m)\mathrm{cn}(ku, 1/m) = -\mathrm{sn}(u, m)\mathrm{dn}(u, m).\end{aligned}$$

Recall that for $m > 1$ am was defined as

$$\mathrm{am}(u, m) = \arcsin \mathrm{sn}(u, m).$$

Therefore

$$\mathrm{am}'(u, m) = \frac{1}{\sqrt{1 - \mathrm{sn}^2(u, m)}}\mathrm{sn}'(u, m) = \frac{1}{\mathrm{cn}(u, m)}\mathrm{cn}(u, m)\mathrm{dn}(u, m) = \mathrm{dn}(u, m)$$

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