Displacement of permutation

[Award] **7 pts**

[Category] **Math**

Let p be a permutation of the set {1, 2, 3, ..., *n*}. We call the sum the total displacement with *k*th power of *p*. For example, if *p* = (4, 2, 1, 3), *D*1(*p*) = |4-1| + |2-2| + |1-3| + |3-4| = 6, *D*2(*p*) = |4-1|2 + |2-2|2 + |1-3|2 + |3-4|2 = 14, *D*3(*p*) = |4-1|3 + |2-2|3 + |1-3|3 + |3-4|3 = 36.

For any positive integer *n*, assume every possible permutation *p* of the set {1, 2, 3, ..., *n*} is uniformly distributed. Let *E*(*n*) be the expected value of *D*1(*p*) + *D*2(*p*) + *D*3(*p*). You are given *E*(2) = 3, E(3) = 40/3, E(5) = 432/5, and all *E*(*n*) are rational number. Let *F*(*n*) be the numerator of *E*(*n*) with *E*(*n*) be fraction in lowest terms. So, *F*(2) = 3, *F*(3) = 40, *F*(5) = 432 and so on.

Let *S*(*n*) =. Find S(12345678987654321) mod 1000000007.

Thanks to **baihacker** for the idea.

[Answer] **202497928**