Hence, (6) has

$$(m-2)\left(\left\lfloor\frac{k^p}{m}\right\rfloor+\frac{1+(-1)^{p+1}}{2}\right)(t+1)$$

distinct solutions.

(b) $r_1 \not\equiv m-p \pmod m$ *and* $r_2 \equiv m-1 \pmod m$

In this case, (7) has exactly one solution, (8) has

$$\left\lfloor\frac{k^p}{m}\right\rfloor+\frac{1+(-1)^{p+1}}{2}$$

distinct solutions and (9) has t distinct solutions. Hence (6) has

$$\left(\left\lfloor\frac{k^p}{m}\right\rfloor+\frac{1+(-1)^{p+1}}{2}\right)t$$

distinct solutions.

(c) $r_1 \equiv m-p \pmod m$ *and* $r_2 \not\equiv m-1 \pmod m$

In this case, (7) has exactly one solution, (8) has

$$\left\lfloor\frac{k^p}{m}\right\rfloor+\frac{1+(-1)^{p}}{2}$$

solutions and (9) has $t+1$ distinct solutions. Hence, (6) has

$$\left(\left\lfloor\frac{k^p}{m}\right\rfloor+\frac{1+(-1)^{p}}{2}\right)(t+1)$$

distinct solutions.

From *(a)*, *(b)*, *(c)* and Lemma 3.2, we conclude that (2) has totally

$$(m-2)\left(\left\lfloor\frac{k^p}{m}\right\rfloor+\frac{1+(-1)^{p+1}}{2}\right)(t+1)+\left(\left\lfloor\frac{k^p}{m}\right\rfloor+\frac{1+(-1)^{p+1}}{2}\right)t+\left(\left\lfloor\frac{k^p}{m}\right\rfloor+\frac{1+(-1)^{p}}{2}\right)(t+1)=\left\lfloor\frac{k^{p+1}}{m}\right\rfloor+\frac{1+(-1)^{p+2}}{2}$$

distinct solutions. That is Lemma 3.5 is also true for $N = p+1$ and $r \not\equiv m-p-1 \pmod m$.

Therefore, Lemma 3.5 follows from mathematical induction.

Q.E.D.

From Lemma 3.3, Lemma 3.4 and Lemma 3.5, we immediately have the proof of Theorem 3.1.

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