Number of surjective maps $f: X \to Y$ where $|X| = m$, $|Y| = n$ and $m \geq n$.

Let S be the set of all maps from $X \to Y$ and let $Y = \{1, \dots, n\}$.

Let S_i be the set of maps $X \to Y$ s.t. i does <u>not</u> belong to the image of the map.

Then the set of surjective map $= S - \bigcup_i S_i$ (Why?)

$|S| = n^m$.

$$\left|\bigcup_i S_i\right| = \sum_i |S_i| - \sum_{i<j} |S_i \cap S_j| + \sum_{i<j<k} |S_i \cap S_j \cap S_k| - \dots\dots,$$

$$= n \cdot (n-1)^m - \binom{n}{2} (n-2)^m + \binom{n}{3} (n-3)^m - \dots\dots$$

(this step is because of "inclusion-exclusion" principle that we did not discuss).

Hence, the number of surjective maps

$$= \underbrace{n^m - n \cdot (n-1)^m + \binom{n}{2} (n-2)^m + \dots + (-1)^{n-1} \binom{n}{n-1} 1^m}_{= 6}$$

If $m = 3$, $n = 2$

$\boxed{\text{DO NOT WORRY ABOUT THIS FOR THE TEST}}$