AI1110 Assignment 2 in LaTeX

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12.13.4.4 Question:
Find the probability distribution of
(i) number of heads in two tosses of a coin.
(ii) number of tails in the simultaneous tosses of three coins.
(iii) number of heads in four tosses of a coin.

Solution:
(i) Let X be the random variable representing the number of heads in two tosses of a fair coin. X can take values {0, 1, 2}.

P(X=r) = $\binom{n}{r}$ $(p)^r$ $(1-p)^{n-r}$, here p = $\frac{1}{2}$, ∴ P(X=r) = $\binom{n}{r}$ $(\frac{1}{2})^n$.

$$P(X=0) = \binom{2}{0}\frac{1}{2^2} = \frac{1}{4} \tag{1}$$
$$P(X=1) = \binom{2}{1}\frac{1}{2^2} = \frac{2}{4} = \frac{1}{2} \tag{2}$$
$$P(X=2) = \binom{2}{2}\frac{1}{2^2} = \frac{1}{4} \tag{3}$$

(ii) Let Y be the random variable representing the number of tails in simultaneous tosses of 3 coins. Y can take values {0, 1, 2, 3}.

P(Y=r) = $\binom{n}{r}$ $(p)^r$ $(1-p)^{n-r}$, here p = $\frac{1}{2}$, ∴ P(Y=r) = $\binom{n}{r}$ $(\frac{1}{2})^n$.

$$P(Y=0) = \binom{3}{0}\frac{1}{2^3} = \frac{1}{8} \tag{4}$$
$$P(Y=1) = \binom{3}{1}\frac{1}{2^3} = \frac{3}{8} \tag{5}$$
$$P(Y=2) = \binom{3}{2}\frac{1}{2^3} = \frac{3}{8} \tag{6}$$
$$P(Y=3) = \binom{3}{3}\frac{1}{2^3} = \frac{1}{8} \tag{7}$$

(iii) Let Z be the random variable representing the number of heads in four tosses of a coin. Z can take values {0, 1, 2, 3, 4}.

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P(Z=r) = $\binom{n}{r}$ $(p)^r$ $(1-p)^{n-r}$, here p = $\frac{1}{2}$, $\therefore$ P(Z=r) = $\binom{n}{r}$ $(\frac{1}{2})^n$.

$$P(Z = 0) = \binom{4}{0}\frac{1}{2^4} = \frac{1}{16} \tag{8}$$

$$P(Z = 1) = \binom{4}{1}\frac{1}{2^4} = \frac{4}{16} = \frac{1}{4} \tag{9}$$

$$P(Z = 2) = \binom{4}{2}\frac{1}{2^4} = \frac{6}{16} = \frac{3}{8} \tag{10}$$

$$P(Z = 3) = \binom{4}{3}\frac{1}{2^4} = \frac{4}{16} = \frac{1}{4} \tag{11}$$

$$P(Z = 4) = \binom{4}{4}\frac{1}{2^4} = \frac{1}{16} \tag{12}$$