Quiz 4 AI1110

## 1 Definitions

1) The $Z$ transform of $X$ is defined as

$$M_X(z) = E\left(z^{-X}\right) = \sum_{k=-\infty}^{\infty} z^{-k} p_X(k) \tag{1.1}$$

2) Let $X$ be a random variable with pmf.

$$p_X(k) = \begin{cases} 1/6 & 1 \le k \le 6 \\ 0 & \text{otherwise} \end{cases} \tag{1.2}$$

$X$ is said to be Discrete Uniform Random Variable

3) Convolution of two sequences using Toeplitz matrices

$$\mathbf{y} = \mathbf{x} \circledast \mathbf{h} \tag{1.3}$$

$$\mathbf{y} = \begin{pmatrix} h_1 & 0 & . & . & . & 0 \\ h_2 & h_1 & . & . & . & 0 \\ h_3 & h_2 & h_3 & . & . & 0 \\ h_{m-1} & . & . & . & h_2 & h_1 \\ h_m & h_{m-1} & . & . & . & h_2 \\ . & . & . & . & . & . \\ . & . & . & . & . & . \\ 0 & 0 & . & . & . & h_m \end{pmatrix} \begin{pmatrix} x_1 \\ x_2 \\ . \\ . \\ . \\ . \\ x_n \end{pmatrix} \tag{1.4}$$

## 2 Problems

1. If $\mathbf{x} = \mathbf{h} = \frac{1}{2}\begin{pmatrix} 1 \\ 1 \end{pmatrix}$, find $\mathbf{y}$.
2. Find $p_{X_1}(k) \circledast p_{X_2}(k)$ using toeplitz matrices.
3. Find $M_Y(z)$, such that $Y = X_1 + X_2$
4. Find $p_Y(k)$