## 1 Definitions

1. The mean of $Y$ is defined as

$$E(Y) = \sum_k k p_Y(k) \tag{1.1.1}$$

2. The MGF of $X$ is defined as

$$M_X(s) = E\left(e^{-sX}\right) \tag{1.2.1}$$

3. Let $X \sim \mathcal{N}(0,1)$. Then the $Q$ function is defined as,

$$Q(x) = \Pr(X > x), \quad x \geq 0 \tag{1.3.1}$$

## 2 Problems

1. Show that

$$E(Y) \geq \sum_{k=m}^{\infty} p_Y(k), \quad m > 0 \tag{2.1.1}$$

2. Show that

$$\Pr(Y > m) \leq \frac{E(Y)}{m}, \quad m > 0 \tag{2.2.1}$$

3. Using (2.2.1), show that Show that

$$\Pr\left([Y - E(Y)]^2 > b^2\right) \leq \frac{var(Y)}{b^2}, \quad b > 0 \tag{2.3.1}$$

4. Show that

$$\Pr(|Y - E(Y)| > b) \leq \frac{var(Y)}{b^2}, \quad b > 0 \tag{2.4.1}$$

5. Show that

$$\Pr(X > a) = \Pr\left(e^{-sX} > e^{-sa}\right), \quad s < 0 \tag{2.5.1}$$

6. Using (2.2.1), show that

$$\Pr(X > a) \leq e^{as} M_X(s), \quad s < 0 \tag{2.6.1}$$

7. Show that the MGF of $X$ is

$$M_X(s) = e^{\frac{1}{2}s^2} \tag{2.7.1}$$

8. Using (2.6.1) show that

$$Q(x) \le e^{-\frac{x^2}{2}} \tag{2.8.1}$$