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CAT 1

1. (a)

i) Continuous random variable: Takes any value in an interval
e.g. temperature.

ii) Expectation: The average value you expect.

$$\text{Formula: } E(X) = \sum x \cdot P(x)$$

(b) Can experiment

Flip a coin

• $X = 1$ if Heads, $X = 0$ if Tails

• $P(X=1) = 0.5$, $P(X=0) = 0.5$

Its random because we can't predict it

(c) Die game

• $X = 2$ (if 1), $X = 1$ (if 6), $X = -1$ (if 2-5)

• $P(X=2) = 1/6$, $P(X=1) = 1/6$, $P(X=-1) = 4/6$

• $E(X) = -1/6 \approx -0.167 \rightarrow$ You lose on average

(d) Given PDF: $f(x) = 3.6x - 2.4x^2$ for $0 < x < 1$

• Mean = 0.6

• Variance = 0.06

• $P(X > 0.5) = 0.65$

• Median: ~ 0.63

2. (a) Flight overbooking

110 tickets, 100 seats

$P(\text{more show up}) \sim 0.96$

(b) Poisson claims

$\lambda = 2 \rightarrow \text{std dev} = \sqrt{2} = 1.41$

(c) 75 defective fans

$\lambda = 32$ (from 800×0.04)

$P(X = 75) \approx 0$ (very small)

(d) Accidents (Poisson $\lambda = 2$)

i) $P(1 \text{ day}) = 0.2707$

ii) $P(0-2 \text{ days}) = 0.6767$

e) claim sizes

$$\text{Mean} = 53.50 = 18.5$$

$$\text{Range} = (34.5, 71.5)$$

$$\% \text{ within } \pm 1 \text{ SD} = 45\%$$

(f)

Geometric ($p = 0.05$)

$$E(X) = 20$$

$$P(X \neq 3) = 0.045$$

$$P(X \leq 5) = 0.226$$

$$P(X > 10) = 0.599$$

(g)

Negative Binomial ($r=3, p=0.2$)

$$P(X=10) = 0.060$$

$$P(X \leq 12) = 0.857$$

$$\text{Variance} = 60$$