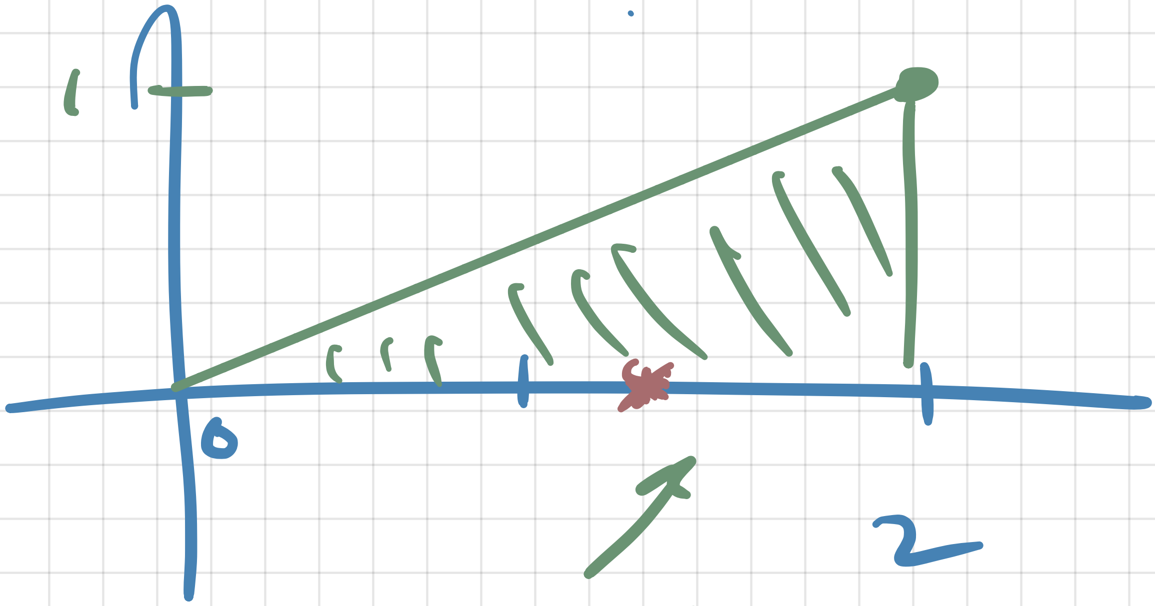
#4 on NOTEBOOK

X is a cont. RV w/

$$f(x) = \begin{cases} \frac{x}{2} & 0 \le x \le 2 \\ 0 & \text{ELSE} \end{cases}$$



$E[X]$

$$E[X] = \int_{-\infty}^{\infty} x f(x)\,dx = \int_0^2 x \cdot \frac{x}{2}\,dx$$

$$= \int_0^2 \frac{x^2}{2}\,dx = \frac{x^3}{6}\Big|_0^2$$

$$= \frac{2^3}{6} - \frac{0^3}{6} = \frac{8}{6} = \boxed{\frac{4}{3}}$$

$$VAR(X) = \int_{-\infty}^{\infty} (x-\mu)^2 f(x)\,dx$$

$$= \int_0^2 \left(x - \frac{4}{3}\right)^2 \cdot \frac{x}{2}\,dx$$

$$= \int_0^2 \left(x^2 - \frac{8}{3}x + \frac{16}{9}\right) \cdot \frac{x}{2}\,dx$$

$$= \int_0^2 \frac{x^3}{2} - \frac{4}{3}x^2 + \frac{8}{9}x\,dx$$

$$= \frac{x^4}{8} - \frac{4}{9}x^3 + \frac{4}{9}x^2 \Big|_0^2$$

$$= \frac{16}{8} - \frac{4}{9}\cdot 8 + \frac{4}{9}\cdot 4 = \boxed{\frac{2}{9}}$$

$$VAR(X) = E[X^2] - \underline{(E[X])^2}$$

$$E[X^2] = \int_0^2 x^2 \cdot \frac{x}{2}\,dx = \frac{x^4}{8}\Big|_0^2$$

$$= 2 \Rightarrow VAR(X) = 2 - \left(\frac{4}{3}\right)^2$$

$$VAR(X) = 2 - \frac{16}{9} = \frac{18}{9} - \frac{16}{9} = \frac{2}{9}$$

#c) $E[Y]$ WHERE $Y = 2X+3$

$$E[Y] = E[2X+3]$$
$$= 2E[X] + E[3]$$
$$= 2E[X] + 3$$
$$= 2 \cdot \frac{4}{3} + 3 = \frac{8}{3} + 3$$
$$= \frac{8}{3} + \frac{9}{3} = \boxed{\frac{17}{3}}$$

$$E[2X+3] = \int_0^2 (2x+3)\,\frac{x}{2}\,dx$$

$$VAR(Y) = VAR(2X+3) = VAR(2X)$$
$$= 4VAR(X) = 4 \cdot 2/9 = \boxed{8/9}$$

GRAPHICAL SUMMARIES

38, 41, 41, 41, 41, $\boxed{42}$, 43, 44, 44, 48, 45

NEEDS Q_1, Q_2, Q_3, IQR

$n = 11$ (ODD)

$Q_2 = 42$

38, 41, $\underline{41, 41}$, 41, 42

42, 43, $\underline{44, 44}$, 48, 45

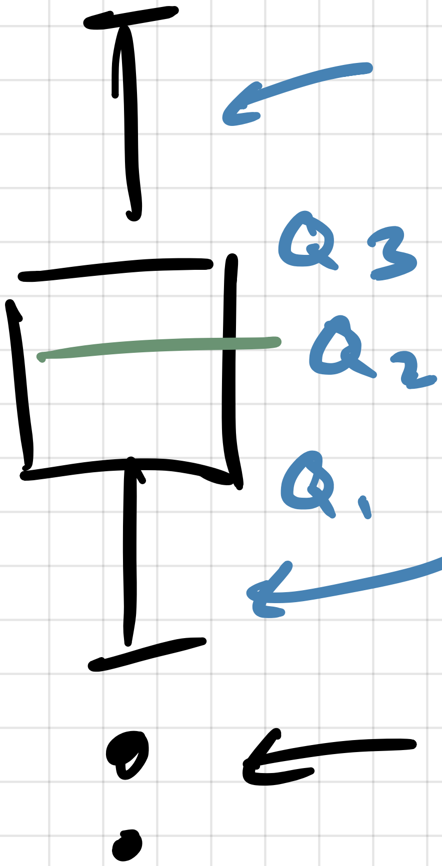
$Q_1 = \frac{41+41}{2} = 41$

$Q_3 = \frac{44+44}{2} = 44$

$Q_1 = 41$ $Q_2 = 42$ $Q_3 = 44$

$Q_1 = 41 \quad Q_2 = 42 \quad Q_3 = 44$

$IQR = Q_3 - Q_1 = 44 - 41 = 3$



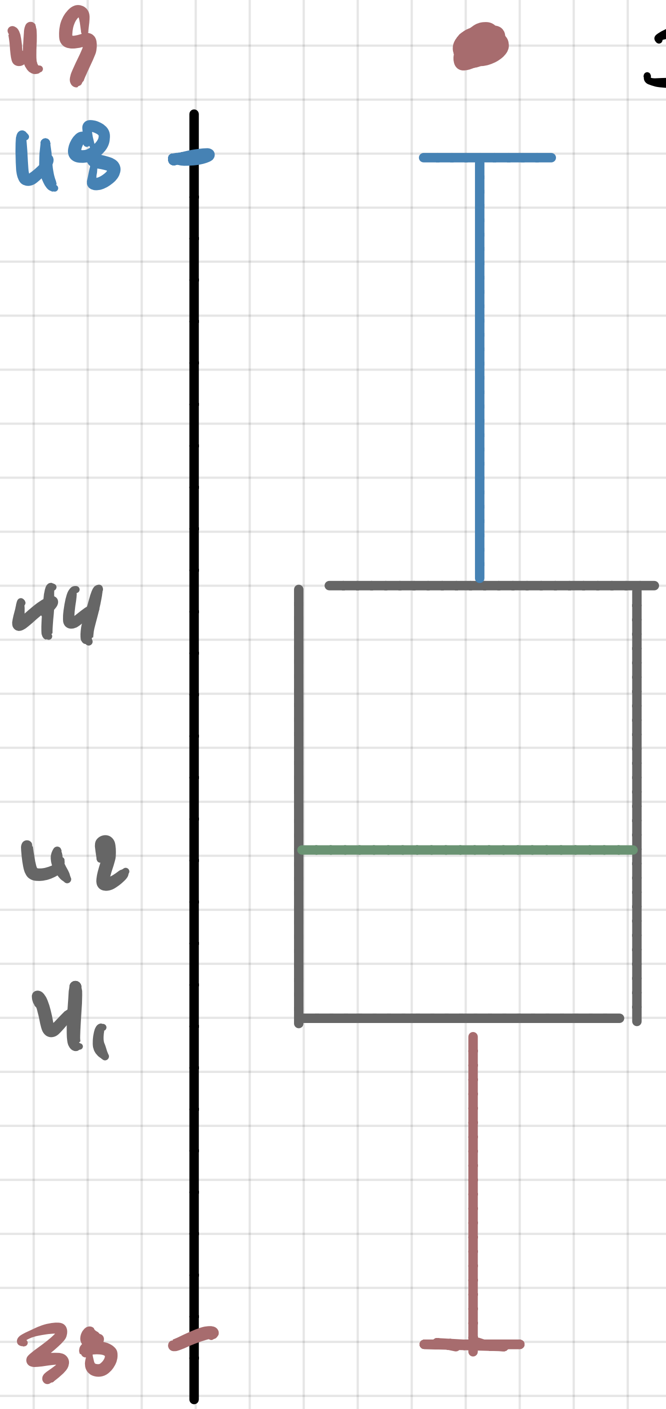
1.5 × IQR
BUT TO FARTHEST DATA POINT

FIERS = All points outside of whiskers.

38, 41, 41, 41, 41, $\boxed{42}$, 43, 44, 44, 48, 45

$Q_1 = 41$ $Q_2 = 42$ $Q_3 = 44$

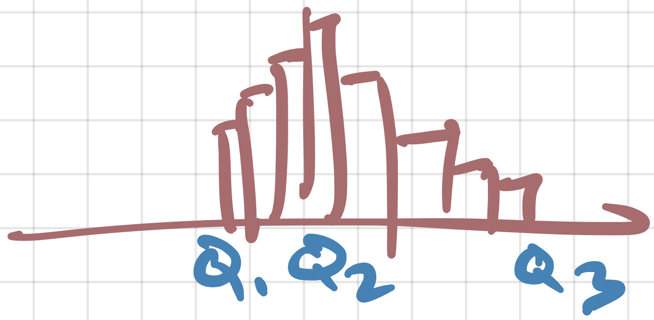
IQR = 3



TOP WHISKER

$$Q_3 + 1.5 * IQR$$
$$= 44 + \frac{3}{2} \cdot 3$$
$$= 44 + 4.5$$
$$= 48.5$$

$$Q_1 - 1.5 * IQR$$
$$= 41 - 1.5 * 3$$
$$= 41 - 4.5$$
$$= 36.5$$



Exponential vs Poisson

CONTINUOUS RV

time intervals between arrivals

DISCRETE RV

# of arrivals in fixed time per

BOTH PARAM'ED BY λ = AVERAGE RATE OF ARRIVALS (arrivals per time PERIOD)

$$f(t) = \begin{cases} \lambda e^{-\lambda t} & t \geq 0 \\ 0 & \text{else.} \end{cases}$$

pdf

$$P(X=k) = \frac{\lambda^k e^{-\lambda}}{k!}$$

pmf

EXP

$$F(t) = \begin{cases} 0 & t < 0 \\ 1 - e^{-\lambda t} & t \geq 0 \end{cases}$$

$$\frac{d}{dt} F(t) = \frac{d}{dt}\left(1 - e^{-\lambda t}\right)$$

$$= 0 - (-\lambda) e^{-\lambda t}$$

$$= \lambda e^{-\lambda t}$$

POIS

$$P(X \leq k) = \sum_{i=0}^{k} \frac{\lambda^i e^{-\lambda}}{i!}$$

<u>CONT</u>: EXP, UNIFORM, NORMAL

<u>DISC</u>: DISCRETE UNIFORM, NEGATIVE BINOMIAL, GEOMETRIC, POISSON, BERNOULLI, BINOMIAL

Ber(p)

1 coin flip

$X = \{0, 1\}$

Bin(n, p)

successes in n trials

Trials must be indep & have prob of success p.

* 1% of men have cancer
* 90% w/ cancer will test +
* 8% w/o cancer will test +

WHAT IS PROB THAT SOMEONE WHO TEST +VE HAS CANCER

C = EVENT HAS CANCER

+ = EVENT TESTS POS

− = EVENT TESTS NEG

<u>GOAL:</u> $P(C \mid +)$

$P(C) = .01$ $\quad P(+ \mid C) = .9$

$P(C^c) = 1 - P(C)$
$= 0.99$ $\quad P(+ \mid C^c) = .08$

$P(- \mid C) = 1 - P(+ \mid C) = 0.1$

$P(- \mid C^c) = 1 - P(+ \mid C^c) = .92$

<u>Goal:</u> $P(C \mid +)$

$P(C) = .01 \qquad P(+ \mid C) = .9$

$P(C^c) = 1 - P(C) \qquad P(+ \mid C^c) = \underline{\underline{.08}}$

$= 0.99$

$P(- \mid C) = 1 - P(+ \mid C) = 0.1$

$P(- \mid C^c) = 1 - P(+ \mid C^c) = .92$

$$P(C \mid +) = \frac{P(+ \mid C)\,P(C)}{P(+)}$$

$$= \frac{P(+ \mid C)\,P(C)}{P(+ \mid C)\,P(C) + P(+ \mid C^c)\,P(C^c)}$$

$$= \frac{.9 \times .01}{.9 \times .01 + .08 \times .99}$$

$$= 0.102$$

$$P(c \mid ++)$$

$$= \frac{P(++ \mid c)\,P(c)}{P(++)}$$

$$= \frac{P(++ \mid c)\,P(c)}{P(++ \mid c)\,P(c) + P(++ \mid c^c)\,P(c^c)}$$

$$P(++ \mid c) = P(+ \mid c)\,P(+ \mid c)$$

$$= .9^2 = .81$$

$$P(++ \mid c^c) = P(+ \mid c^c)\,P(+ \mid c^c)$$

$$= .08 \times .08 = .0064$$

$$= \frac{.81 \times .01}{.81 \times .01 + .0064 \cdot .99}$$

$$= 0.56$$