



# ASQ CRE Prep course

Lesson II. A. 3. a.

Probability Distributions

The Four Functions

A serene sunset scene over a body of water. The sun is a small, bright orange orb on the horizon, casting a long, shimmering reflection down the center of the water. The sky is filled with soft, dark clouds, and the water's surface is textured with gentle ripples. In the bottom left corner, a portion of a dark, craggy rock is visible.

A way to answer questions based on your data

# THE FOUR FUNCTIONS



# Probability Density Function

- **Think Histogram**
- **Mathematically**

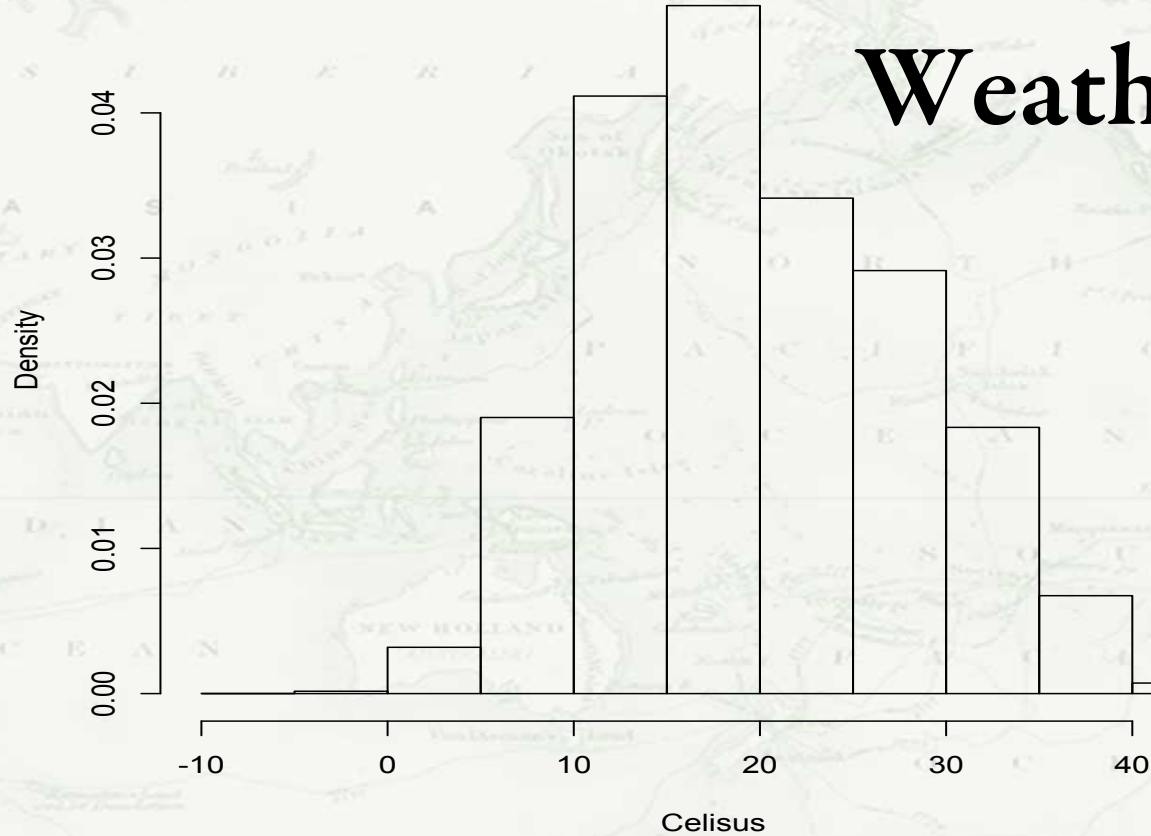
$$\int_{-\infty}^{\infty} f(t) dt = 1$$

$$\sum_k f(k) = 1$$

**For all values of t or k, and  $f(x) \geq 0$**

## 1990 - 2010 California Temperatures (°C)

# Weather Data



# Cumulative Density Function

$$F(x) = \int_{-\infty}^x f(\tau) d\tau$$

$$F(k) = \sum_{k_i \leq k} f(k_i)$$

# CDF Example

**Time to fail for motor has following PDF**

$$f(t) = 0.02e^{-0.02t}$$

**What probability of failure before  $t = 100$**

# Reliability Function

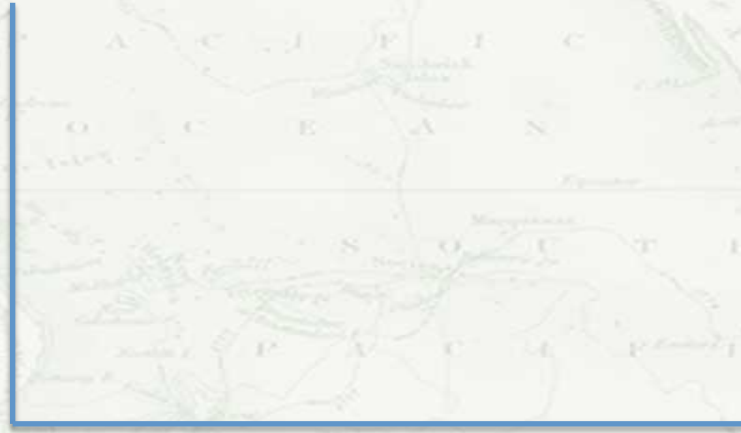
$$R(x) = \int_x^{\infty} f(\tau) d\tau = 1 - \int_{-\infty}^x f(\tau) d\tau$$



# Hazard Function

- **A measure of tendency to fail**
- **Instantaneous failure rate**

$$h(x) = \frac{f(x)}{R(x)}$$





# Given one function derive the others

$$h(x) = \frac{f(x)}{R(x)}$$

$$F(x) = 1 - R(x)$$

$$R(x) = e^{-\int_{-\infty}^x h(\tau) d\tau}$$

$$f(x) = h(x) e^{-\int_{-\infty}^x h(\tau) d\tau}$$

Just getting  
started with  
formulas



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Lesson II. A. 3. b.

Probability Distributions

Continuous Distributions