14.32 Recitation 1

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Fall 2023

Table of Contents

Table of Contents

Logistics

- Office Hours (Room E52-516)
  - Nina: Monday 5 - 6
  - Ian: Wednesday 5 - 6

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- Office Hours (Room E52-516)
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- Recitation (Room E51-149)
  - Nina: Recitation 1, 3-7
  - Ian: Recitation 2, 8-12

Logistics

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- First Pset is out, due on Thursday, Sep 28th

Table of Contents

Probability

- Random Variables
- Expectation
- Variance
- Gaussian Distribution

Random Variables

- Discreet vs. Continuous
- CDF - $P(X \leq x)$
  - $F_x(X) = P(X \leq x)$
  - The CDF is always between 0 and 1
- PDF
  - $f_x(X) = P(a < x \leq b) = F_x(b) - F_x(a)$
  - The PDF must always integrate to 1
- $\frac{d}{dx}F(x) = f(x)$

Expectation

Expectation formulas

$$\textbf{Discreet:}\ \ E(x) = \sum x_i p_i$$

$$\textbf{Continuous:}\ \ E(x) = \int_{-\infty}^{\infty} x_i f_x(x_i) dx$$

Properties of Expectation

- $E[c] = c$
- $E[a + bX] = a + bE[X]$
- $E[X + Y] = E[X] + E[Y] \longrightarrow E\left[\sum X_i\right] = \sum E[X_i]$
- $E[XY] = E[X]E[Y]$ **only if X and Y are independent**

Variance

Variance Formulas

$$\sigma^2 = E[(X - E[X])^2] = E[X^2] - (E[X])^2$$

Properties of Variance

- $Var(bX + a) = b^2 Var(X)$
- $Var(X + Y) = Var(X) + Var(Y) + 2Cov(X, Y)$
    - if X and Y are independent random variables, $Cov(X, Y) = 0$
- **For X** $\sim$ **Ber(p)**, $Var(X) = p(1 - p)$

Gaussian Distribution

The Gaussian Distribution (or Normal Distribution) is notated as

$$X \sim N(\mu, \sigma^2)$$

Standard Normal Distribution

$$X \sim N(0, 1)$$

PDF of Normal Distribution

$$f(x) = \frac{1}{\sqrt{2\pi\sigma^2}} exp\left(-\frac{(x-\mu)^2}{2\sigma^2}\right)$$

Properties of Normal Distribution

- $\int_{-\infty}^{+\infty} f(x)dx = 1$;
- $\int_{-\infty}^{+\infty} xf(x)dx = \mu$;
- $\int_{-\infty}^{+\infty} (x - mu)^2 f(x)dx = \sigma^2$;
- If $X \sim N(\mu, \sigma^2)$, and $Y = a + bX$, then $Y \sim N(a + b\mu, b^2\sigma^2)$.
- If $X \sim N(\mu, \sigma^2)$, then $\frac{X-\mu}{\sigma} \sim N(0, 1)$.

Table of Contents

Stata Installation

- Download from the Econ website (strongly recommend) https://econ-help.mit.edu/kb/stata-license/
- Use Serial Number, Code, and Authorization from the attached pdf

Stata Demonstration

- Summarization, generating variables, graphing, regression

Stata Demonstration

- Summarization, generating variables, graphing, regression
- Download **14.32_rec1.do** and **wellness.dta** from Canvas
    - In recitation 1 folder

Stata Demonstration

Regression Output Description: