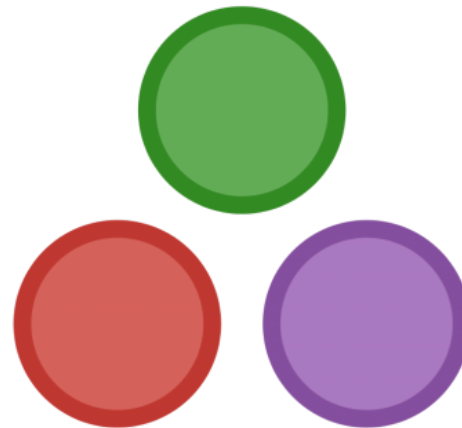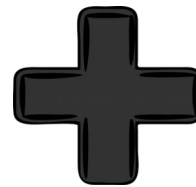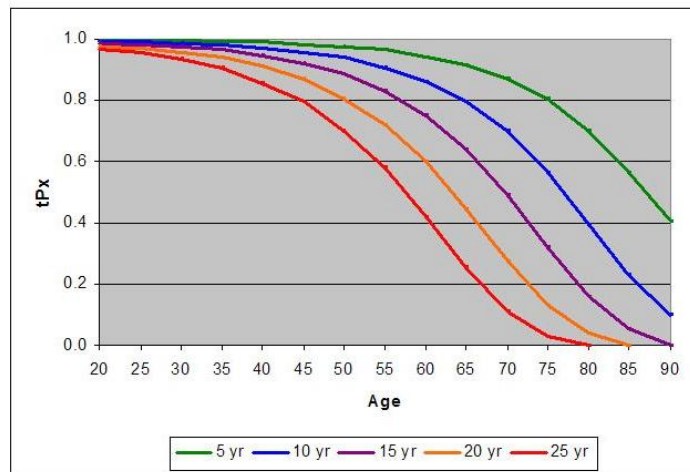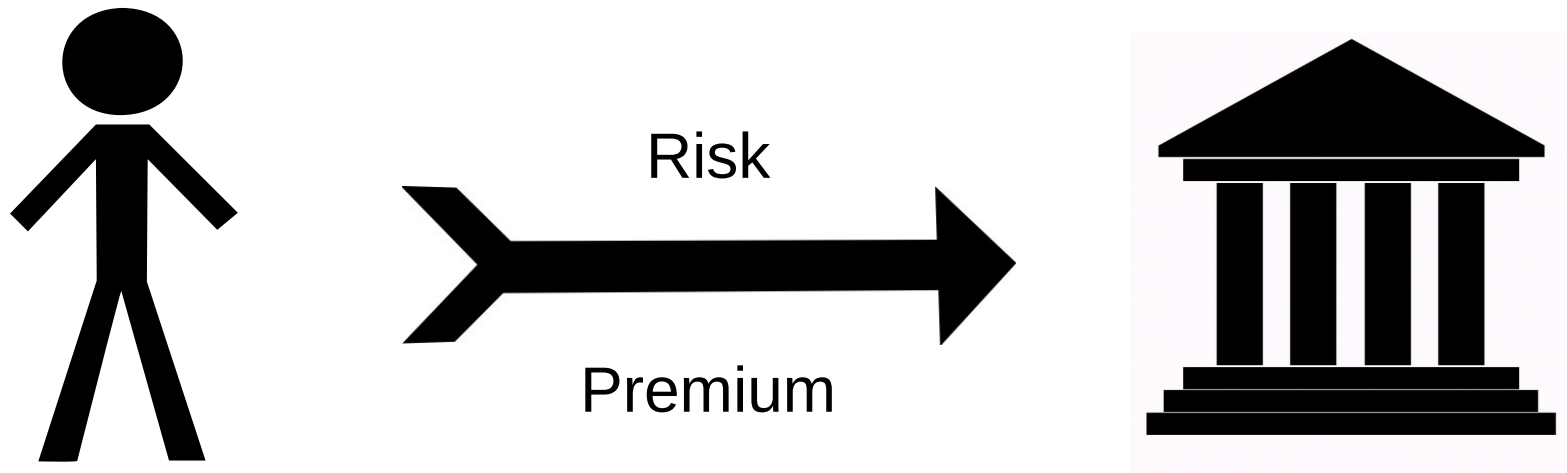# Actuarial Science
# with Julia



Presented by: Rock Pereira

# What Is Insurance?

Risk

Premium

# Contents

1. Present Value, Types of Policies

2. Force of Morality, Life Tables

3. Modeling a Term Life Policy

4. Modeling a Whole Life Policy

5. Simulation Analysis of MANY Policies

6. Effect of Risk Factors on Premiums

# Section 1: Present Value

## 1.1 Annuity Immediate

| Year | 0 | 1 | 2 | 3 | 4 | ... | n-1 | n |
|---|---|---|---|---|---|---|---|---|
| Premium | P | | | | | | | |
| Claim | | C | C | C | C | C | C | C |

PV Premiums = P

PV Claims = $C / (1+i)^1 + C / (1+i)^2 + ... C / (1+i)^n$

Discount $v = 1 / (1+i)$

# 1: Present Value

## 1.2 Annuity Deferred

| Year | 0 | 1 | 2 | ... | 10 | 11 | 12 | ... | n |
|---|---|---|---|---|---|---|---|---|---|
| Premium | P | P | P | P | | | | | |
| Claim | | | | | | C | C | C | C |

|---------Savings Phase-------|          |---------Income Phase-------|

PV Premiums = $P + P * v^1 + P * v^2 + ... + P * v^9$

PV Claims = $C * v^{11} + C * v^{12} + ... + C * v^n$

# 1: Present Value

## 1.3 Term Life Insurance

| Year | 0 | 1 | 2 | ... | Death | | | n-1 | n |
|---|---|---|---|---|---|---|---|---|---|
| Premium | P | P | P | P | P | | | | |
| Claim | | | | | | C | | | |

## 1.4 Whole Life Insurance

| Age | 40 | 41 | 42 | ... | Death | | | 99 | Maturity |
|---|---|---|---|---|---|---|---|---|---|
| Premium | P | P | P | P | P | | | | |
| Claim | | | | | | C | | | |

# Section 2: Life Tables

| Age | Probability of dying between ages x to x+1 q(x) | Number surviving to age x l(x) | Number dying between ages x to x+1 d(x) | Person-years lived between ages x to x+1 L(x) | Total number of person-years lived above age x T(x) | Expectation of life at age x e(x) |
|---|---|---|---|---|---|---|
| 0–1 | 0.006123 | 100,000 | 612 | 99,465 | 7,866,027 | 78.7 |
| 1–2 | 0.000428 | 99,388 | 43 | 99,366 | 7,766,561 | 78.1 |
| 2–3 | 0.000275 | 99,345 | 27 | 99,331 | 7,667,195 | 77.2 |
| 3–4 | 0.000211 | 99,318 | 21 | 99,307 | 7,567,864 | 76.2 |
| 4–5 | 0.000158 | 99,297 | 16 | 99,289 | 7,468,556 | 75.2 |
| 5–6 | 0.000145 | 99,281 | 14 | 99,274 | 7,369,267 | 74.2 |
| | | | | | | |
| 94–95 | 0.206214 | 11,447 | 2,361 | 10,267 | 39,478 | 3.4 |
| 95–96 | 0.224274 | 9,087 | 2,038 | 8,068 | 29,211 | 3.2 |
| 96–97 | 0.243080 | 7,049 | 1,713 | 6,192 | 21,144 | 3.0 |
| 97–98 | 0.262527 | 5,335 | 1,401 | 4,635 | 14,951 | 2.8 |
| 98–99 | 0.282492 | 3,935 | 1,112 | 3,379 | 10,316 | 2.6 |
| 99–100 | 0.302838 | 2,823 | 855 | 2,396 | 6,937 | 2.5 |
| 100 and over | 1.000000 | 1,968 | 1,968 | 4,542 | 4,542 | 2.3 |

Table 1. Life table for the total population: United States, 2010

# 7: Sources

Life Tables (All 18 Tables)

ftp://ftp.cdc.gov/pub/Health_Statistics/NCHS/Publications/NVSR/63_07/