

Motorcyclist Tailored Term Assurance

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Chapter 1: Introduction

Understanding the Boda Boda Sector and the Insurance Gap

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1.1 The Core Problem

Systematic Mispricing

- Conventional life insurance relies on general assured-lives mortality assumptions.
- These tables drastically underestimate the extreme accident risk of boda boda riders.
- **Result:** Premiums are either unaffordable due to excessive risk buffering, or the insurer faces adverse selection and insolvency.

The Behavioral Gap (Moral Hazard)

- Fixed premiums fail to account for dynamic behavioral choices (speeding, harsh braking).
- There is no financial incentive for safe riding, exacerbating overall mortality rates.



1.2 Project Objectives



1. Risk Modeling

Construct a multiple-decrement mortality basis integrating NTSA road traffic accident (RTA) mortality with general mortality (KE 2007–2010).



2. Dynamic Pricing

Develop a Generalized Linear Model (GLM) to derive a continuous Risk Factor from telematics data, adjusting premiums dynamically.



3. Financial Inclusion

Ensure the calculated base premium is affordable relative to average rider income (KES 6,600/week) and operationalize via mobile money.

Chapter 2: literature review

Occupational Risk, Telematics, and Pricing Frameworks

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2.1 Key Theoretical Foundations

Occupational Hazard

Boda boda riders face exceptionally high mortality and injury rates. Poor training, variable helmet usage, and congested urban environments make them a specialized high-risk cohort.

Telematics & UBI

Usage-Based Insurance (UBI) utilizes telematics to monitor speed, acceleration, and braking. It addresses moral hazard by creating a direct feedback loop: risky behavior increases costs; safe riding earns discounts

Actuarial Pricing Models

Multiple-Decrement Models: Provide the structure to combine cause-specific forces of mortality (RTA) with general survival probabilities.

Generalized Linear Models (GLMs): The standard for translating non-normal response variables (like telematics scores) into multiplicative premium risk factors via log-link functions.



Chapter 3: Methodology

Constructing the Mortality Basis and Dynamic Risk Model

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3.1 Constructing the Mortality Basis

The core methodology involves joining the Kenya Assured Lives Table (2007–2010) with NTSA Road Traffic Accident (RTA) statistics.

- **Target Population:** Male riders aged 18–35 (Actuarial entry age set at 25).
- Extract base mortality probability from general tables.
- Calibrate an independent accident decrement () using NTSA fatality records per active rider.

- Apply Multiple-Decrement Theory to calculate the total survival probability.

$$({}^a p)_x = 1 - ({}^a q)_x^d + ({}^a q)_x^{\text{rtd}}$$



3.2 Product Assumptions & Design

Benefits & Term

- **Benefit Range:** Minimum KES 500,000 to Maximum KES 1,000,000.
- **Payable:** Immediately upon death.
- **Term:** 1-year renewable term assurance
- **Premium Frequency:** Paid weekly for one year to align with cash flows.
- **Interest Rate:** 6% effective annual rate

Expense Structure

Initial Acquisition: KES 250.00 (API KYC, NTSA checks, cloud allocation).

- There is no financial incentive for safe riding, exacerbating overall mortality rates.
- **Recurring Maintenance:** KES 25.00/week (M-Pesa tariffs, cloud computing for Risk Score, SMS feedback).
- **Claim Settlement:** KES 1,500.00 per claim (Manual verification, M-Pesa disbursement).

3.3 Dynamic Risk Modeling

1. Risk Score (S)

Telematics data tracks events (harsh braking, speeding). Events are weighted and aggregated into Total Risk Points (R), then standardized per 100km to yield Score S.

$$S = \frac{R}{\text{Total Distance}} \times 100$$

2. The Priori Log-Linear Model

We use a Log-Linear model to translate score S into a multiplicative Risk Factor (RF). The log-link ensures factors scale the premium exponentially.

$$\ln(RF) = \beta_0 + \beta_1 S$$

3. Premium Adjustment

Ensure the calculated base premium is affordable relative to average rider income (KES 6,600/week) and operationalize via mobile money.

$$P_{\text{adj}} = P_{\text{base}} \times RF$$

Chapter 4: Data Analysis & Results

Applying the Models to Pricing and Affordability

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4.1 Adjusted Rider Mortality (Multiple-Decrement)

Age	q_{xd} (Gen. Pop)	q_{xrtd} (Accident)	$(aq)_{xrtd}$	$(aq)_{xd}$	$(ap)_x$ (Survival)	μ_x (Force of Mort.)
25	0.00193	0.000684	0.001929	0.000683	0.991241	0.002616
26	0.00198	0.001421	0.001978	0.001420	0.996600	0.003406
27	0.00184	0.000654	0.001839	0.000654	0.997507	0.002500

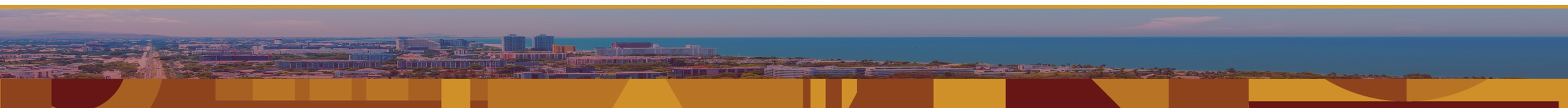
Key Finding: Overlaying RTA risk increases the force of mortality at age 25 from 0.00193 to 0.002616—a roughly **35% increase**. Standard products fail by ignoring this.

4.2 Dynamic Pricing Outcomes

- Using the equivalence principle on the projected cash flows, the **Base Gross Weekly Premium is calculated at KES 55.15**

Rider Profile	Standardized Score (S)	Risk Factor (RF)	Adjusted Weekly Premium (KES)
Gold (Low Risk)	10.61	1.0166	KES 56.07
Standard (Average)	26.51	1.5 (Capped)	KES 82.73
Risky (High Risk)	56.06	1.5 (Capped)	KES 82.73

The pricing mechanism financially penalizes risky behavior while offering affordable rates to safer riders, directly addressing moral hazard.



4.3 Affordability Benchmark

Financial Inclusion Reality Check

- The average Kenyan boda boda rider earns roughly KES 1,100 per day over a six-day workweek
- **Gross Weekly Income: KES 6,600**
- The proposed Base Premium (KES 55.15) represents just **0.833% of the rider's weekly earnings.**
- This falls well below the ILO microinsurance affordability threshold of 3–5%, ensuring frictionless transition toward financial inclusion via digital payments like M-Pesa.



Chapter 5: Conclusion & Recommendations

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Conclusion and Next Steps

Conclusions

Actuarial Soundness: The multiple-decrement model successfully captures the true mortality experience of riders.

Behavioral Pricing: The Priori Log-Linear Model based telematics adjustments allow behavior-linked pricing, managing moral hazard.

Commercial Viability: At 0.83% of income, the product is highly affordable and scalable via mobile money rails.

Recommendations

Controlled Pilot Phase: Calibrate the Priori Log-Linear Model using a closed-cohort pilot to replace assumed data with real-world telematics and claims.

Improve NTSA Data Granularity: Partner with authorities to segment accident data specifically by commercial usage and precise age bands.

Strengthen Tech Partnerships: Ensure robust data flow with ride-hailing apps and SACCOs for real-time premium updates.

