



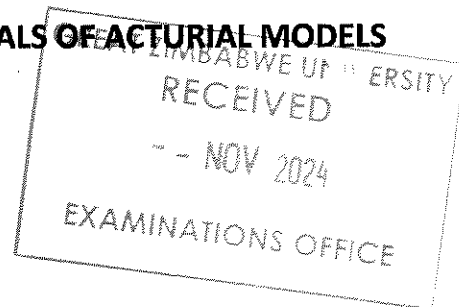
HEBERT CHITEPO SCHOOL OF LAW AND BUSINESS SCIENCES
DEPARTMENT OF ECONOMICS & FINANCE
BACHELOR OF COMMERCE DEGREE
LEVEL 4 SEMESTER 1
EXAMINATION QUESTION PAPER

MODULE CODE HFE 417

MODULE NARRATION FUNDAMENTALS OF FACTORIAL MODELS

DATE 2024

DURATION 3 HOURS



INSTRUCTIONS TO CANDIDATES:

- 1. Answer any four questions**
- 2. All questions carry equal marks**
- 3. Start each answer on a fresh page**
- 4. Show all workings where applicable**

QUESTION 1

(a) State and explain the two commonly used actuarial models [4]

(b). Determine whether each of the model below is deterministic or stochastic.

(i) The monthly payment P on a home or a car loan. [1]

(ii) A modification of the model in (a) is $P + \xi$, where ξ is a random variable introduced to account for the possibility of failure of making a payment. [1]

(iii) Insurance companies use models to estimate their assets and liabilities. Are these models considered deterministic or stochastic? [1]

(c). Explain the following terms

(i) Hazard rate function,

(ii) Survival function

(iii) Excess Loss Random Variable

(iv) Equilibrium distribution

(v) Residual mean lifetime. [15]

(d). For a house insurance policy, the loss amount (expressed in thousands), in the event of a fire, is being modeled by a distribution with density

$$f(x) = \frac{3}{56} x (5 - x), 0 < x < 4$$

For a policy with a deductible amount of \$1,000, calculate the expected amount per loss. [3]

QUESTION 2.

Let X be the random variable with pdf $f(x) = \frac{2}{(1+x)^3}$ for $x \geq 0$ and 0 otherwise

(a) Determine the survival function $S(x)$.

(b) Determine the hazard rate function $h(x)$.

(c) Determine $E(X)$.

(d) Determine the pdf of the equilibrium distribution.

(e) Determine the survival function $S_e(x)$ of the equilibrium distribution.

(f) Determine the hazard function of the equilibrium distribution.

(g) Determine the mean residual lifetime of X . [25]

QUESTION 3.

(a) Explain the factors that determines drawing of the life table figures [10]

(b) In a portfolio of insurance, a claim can be classified as Type A, Type B, or Type C with probabilities 0.2, 0.3, and 0.5 respectively. Suppose that the total number of claims is a Poisson random variable with mean 10. Each type has a Poisson distribution and these random variables are supposed to be independent. What is the probability that out of 5 claims, 2 are of Type A? [10]

(c) State and explain the key considerations for an optimum synthetic portfolio position and equity swaps [5]

QUESTION 4.

(a) Discuss the factors that affect strategic asset allocation [15]

(b) Following the contrarian strategy of asset allocation, comment on the portfolios below

Asset class	Strategic Asset Allocation	Beginning of Year Portfolio	Return	Unbalanced Portfolio	Balanced Portfolio
Stocks	50%	\$5	10%	\$5.50	\$5.38
Bonds	50%	\$5	5%	\$5.25	\$5.38

[10]

QUESTION 5

The need for portfolio revision may emanate from both financial market and investor related factors.

(a) Identify and explain any 4 factors in each category. [12]

(b) A standard risk measure used to evaluate exposure to risk is the value-at risk, abbreviated as VaR. Explain the term value- at risk [13]

(c) Consider a sample of size 8 in which the observed data points were 3,5,6,6,6,7,7, 10. Find $VaR_{0.90}(L)$ for this empirical distribution. [6]

(d) Determine whether VaR is a coherent risk measure or not. Explain your answer. [4]

QUESTION 6.

(a) You are given:

(i) The distribution of the number of claims per policy during a one-year period for 10,000 insurance policies is:

Number of Claims per Policy	Number of Policies
0	5000
1	5000
2 or more	0

(ii) You fit a binomial model with parameters m and q using the method of maximum likelihood.

Determine the maximum value of the Log Likelihood function when $m = 2$.

[15]

(b) You are given:

- (i) The following observed data: 2,3,3,3,5,8,10,13,16.
- (ii) An exponential distribution is fit to the data using maximum likelihood to estimate the mean of the exponential distribution.
- (a) Plot $F_g(x)$ and $F^*(x)$ in the same window.
- (b) Plot $D(x)$.
- (c) Create a $p - p$ plot.

[10]