RGC Ref. No.:

UGC/IIDS14/P01/18

(please insert ref. above)

RESEARCH GRANTS COUNCIL
COMPETITIVE RESEARCH FUNDING SCHEMES FOR
THE LOCAL SELF-FINANCING DEGREE SECTOR

INTER-INSTITUTIONAL DEVELOPMENT SCHEME (IIDS)

Completion Report
(for completed projects only)

Submission Deadlines:	*1. The unspent balance, if applicable, and auditor's report: within **six** months of the approved project completion date.*
	*2. Completion report: within **12** months of the approved project completion date.*

Part A: The Project and Investigator(s)

1. Project Title

Symposium in Reliability Theory and Industrial Statistics

2. Investigator(s) and Academic Department(s) / Unit(s) Involved

Research Team	**Name / Post**	**Unit / Department / Institution**
Principal Investigator	MO Yee-lam / Lecturer	Department of Mathematics, Statistics and Insurance, The Hang Seng University of Hong Kong
Co-Principal Investigator(s)	LEUNG Jacky King-tai / Senior Lecturer	Department of Mathematics, Statistics and Insurance, The Hang Seng University of Hong Kong
	ZEL Stanley Tsz-fung / Senior Lecturer	Department of Mathematics, Statistics and Insurance, The Hang Seng University of Hong Kong
Co-Investigator(s)	CHAN Ping-shing / Associate Professor	Department of Statistics, The Chinese University of Hong Kong
	NG Tony Hon-keung / Professor	Department of Statistical Science, Southern Methodist University
Others		

3.   Project Duration

	Original	**Revised**	**Date of RGC / Institution Approval** *(must be quoted)*
Project Start Date	1 January 2019	N/A	N/A
Project Completion Date	31 December 2019	N/A	N/A
Duration *(in month)*	12	N/A	N/A
Deadline for Submission of Completion Report	31 December 2020	N/A	N/A

Part B: The Final Report

5.   Collaboration with Other Self-Financing Degree-Awarding Institutions

	Name of Institution(s)	% of Participation	Distinctive **Element(s)** of the Institution in Responsible Project
Applying Institution	The Hang Seng University of Hong Kong	100	N/A
Collaborating Institution(s) (If any) #	N/A	N/A	N/A
	N/A	N/A	N/A
	N/A	N/A	N/A
Total:		**100**	

*If no other eligible local self-financing degree-awarding institutions are involved, please input "**N/A**" in this table.*

6.   Project Objectives

6.1   Objectives as per original application

1. To facilitate knowledge exchange among local and overseas researchers from different universities and institutions and all other participants of the symposium through the discussion on recent research and emerging developments in reliability theory and industrial statistics

2. To enhance research proficiency of current researchers in the field of reliability theory and industrial statistics

3. To establish connections between local and overseas academics and industry experts

4. To promote the field of reliability theory and industrial statistics to students and other non-experts

6.2   Revised objectives

Date of approval from the RGC: N/A

Reasons for the change: N/A

6.3   Realisation of the objectives
(Maximum 1 page; please state how and to what extent the project objectives have been achieved; give reasons for under-achievements and outline attempts to overcome problems, if any)

1. All participants agreed that the Symposium facilitated knowledge exchange between the speakers and the audience. Participants also engaged in intellectual discussion after each presentation and during tea breaks.
2. 100% of the researches reflected that the Symposium enhanced the research proficiency in the field of reliability theory and industrial statistics.
3. Connections were established between local and overseas participants through the exchange of ideas after each presentation, during tea breaks, conference lunches and conference dinner.
4. Some students attended the Symposium and reflected that they learned more about recent research in reliability theory and industrial statistics.

6.4   Summary of objectives addressed to date

Objectives	Addressed *(please tick)*	Percentage Achieved *(please estimate)*
1. To facilitate knowledge exchange among local and overseas researchers from different universities and institutions and all other participants of the symposium through the discussion on recent research and emerging developments in reliability theory and industrial statistics	✓	100
2. To enhance research proficiency of current researchers in the field of reliability theory and industrial statistics	✓	100
3. To establish connections between local and overseas academics and industry experts	✓	100
4. To promote the field of reliability theory and industrial statistics to students and other non-experts	✓	95^

^ Only few students came on campus to the symposium.

6.5   Project progress

Original Implementation Schedule	Revised Implementation Schedule (Date of RGC's Approval)	Updated Progress
1. Check availability and confirm the topic of the presentation with potential speakers within 2 months after the funding result is announced	N/A	Completed
2. Design promotional material within 2 months after the funding result is announced	N/A	Completed
3. Finalize date and reserve venue 2 months prior to the date of the symposium	N/A	Completed
4. Arrange accommodation and travel itinerary (if applicable) 2 months prior to the date of the symposium	N/A	Completed

5. Send participating invitation letter to other local UGC funded universities and self-financing degree-awarding institutions 1 month prior to the date of the symposium	N/A	Completed
6. Produce and distribute promotion materials for the symposium 1 month prior to the date of the symposium	N/A	Completed
7. Set up venues and other preparation work (e.g. order refreshments, make reservation for lunch, etc.) 1 – 2 days prior to the date of the symposium	N/A	Completed

6.6   Speaker(s)

Title / Name (Surname in Capital Letters)	Post / Institution	Title / Topic of Presentation / Course	Previous Research Links with Hong Kong Institutions (Nature and Date (Month / Year))
Professor BALAKRISHNAN Narayanaswamy	Professor, McMaster University	Nonparametric Meta-Analysis of Censored Lifetime Data	Presented at the Workshop Series in Applied Statistics at HSUHK in Mar 2015
Dr ZHAO Xingqiu	Professor, The Hong Kong Polytechnic University	Semiparametric Statistical Inference for Functional Cox Model	Professor at Poly U
Professor TANG Loon Ching	Professor, National University of Singapore	Beyond System Reliability: Enhancing Systems Resilience through Recovery and Learning for Re-configurability	N/A
Professor CRAMER Erhard	Professor, RWTH Aachen University	Progressive Censoring and Systems Data	N/A

Dr PENG Chien-Yu	Associate Research Fellow, Institute of Statistical Science, Academia Sinica	Robust Processes for Degradation Analysis	N/A
Professor NG Tony Hon Keung	Professor, Southern Methodist University	Semiparametric and Nonparametric Evaluation of First-Passage Distribution of Bivariate Degradation Processes	Collaborated with Prof CHAN Ben Ping-shing project code: CUHK410410 & CUHK14201015
Dr SIT Tony	Associate Professor, The Chinese University of Hong Kong	Censored Quantile Regression with Time-varying Covariates under Length-biased Sampling	Associate Professor at CUHK
Professor MEEKER William Q.	Professor, Iowa State University	Accelerated Test Methodology to the Predict Service Life of Polymeric Materials Subject to Outdoor Weathering	N/A
Professor NAGARAJA Haikady N.	Professor, The Ohio State University	Distributions of Order Statistics and Their Applications to the Study of System Reliability	N/A
Dr CHAN Ivan Siu Fung	Vice President, Pipeline Statistics and Programing & Global Head of Statistical Sciences , AbbVie Inc.	Precision Medicine in Drug Development – Statistical Innovations and Leadership	N/A
Dr SO Hon Yiu	Postdoctoral Fellow , University of Waterloo	Semiparametric Inference in One-shot Device with Competing Risks	Collaborated with Dr. LING Man Ho

Professor NAGATSUKA Hideki	Professor, Chuo University	On Likelihood-based Interval Estimation Methods for the Generalized Pareto Distribution	N/A
Dr XU Maochao	Professor, Illinois State University	Cybersecurity Risks: Obstacles, Challenges, and Opportunities	N/A
Dr LING Alpha Man Ho	Associate Professor, The Education University of Hong Kong	Step-Stress Accelerated Life Test Plans for One-Shot Devices	Associate Professor at EdUHK

6.7 Please provide details of the activities organized, including the theme / objectives of the activities, targeted participants, attendance, analysis of participants, e.g. country of origin, research background, etc., evaluation forms of the activities and a summary of the participants' evaluation.   Photos of the activities are preferred.)

A 2-day symposium was held on 12 – 13 December 2019 at The Hang Seng University of Hong Kong. A total of 14 speakers have presented during the symposium. The Symposium is open to public. There were around 30 attendees on both days, attracting not only the HSUHK academic staff, but also some research students from City University of Hong Kong and an academic staff from University of Kent.

A survey was done after the Symposium to measure the achievement of the objectives:

Evaluation Survey for the Symposium in Reliability Theory and Industrial Statistics

Thank you for attending the Symposium in Reliability Theory and Industrial Statistics.
Please rate the following items on a scale from 1 to 5.
Skip the question if the item is not applicable to you.

* Required

Which of the following category best describes you? *

○ Speakers

○ Academic Staff

○ Research Staff (e.g. Research Assistant/Research Associate/Research Fellow, etc.)

○ UG/PG Students at Tertiary Institutions

○ Public

The Symposium facilitated knowledge exchange among local and overseas researchers.

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly Agree

The Symposium enhanced research proficiency in the field of reliability theory and industrial statistics.

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly Agree

The Symposium helped establishing connections between local and overseas academics and industry experts.

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly Agree

The Symposium helped promoting the field of reliability theory and industrial statistics to students and other non-experts.

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly Agree

Submit

Which of the following category best describes you?

Category	Count
Academic Staff	17
Speakers	11

	Question	Average (out of 5)
1	The Symposium facilitated knowledge exchange among local and overseas researchers.	5.00
2	The Symposium enhanced research proficiency in the field of reliability theory and industrial statistics.	5.00
3	The Symposium helped establishing connections between local and overseas academics and industry experts.	5.00
4	The Symposium helped promoting the field of reliability theory and industrial statistics to students and other non-experts.	4.96

Some photos of the event:

7. Research-Related Outcome

7.1 Potential for development into research proposal and the proposed course of action
(Maximum half a page)
Papers accepted for publication/published/submitted for publication with the participants of the symposium:.

(1) C. T. Lin, N. Balakrishnan, and M. H. Ling (2020). Exact Tests for Outliers in Laplace Samples. *Communications in Statistics-Simulation and Computation*, 1-22. DOI: 10.1080/03610918.2020.1780444 (Annex II)

(2) M. Hermanns, E. Cramer and H. K. T. Ng (one of the Co-Is). EM Algorithms for Ordered and Censored System Lifetime Data under a Proportional Hazard Rate Model. *Journal of Statistical Computation and Simulation*, 90(18), 3301-3337. (Annex III)

(3) M. H. Ling, P. S. Chan, H. K. T. Ng (one of the Co-Is) and N. Balakrishnan. Copula Models for One-shot Device Testing Data with Correlated Failure Modes. *Communications in Statistics - Theory and Methods*. DOI: 10.1080/03610926.2020.1725827 (Annex IV)

(4) P. S. Chan, H. Y. So, H. K. T. Ng (one of the Co-Is) and W. Gao (2020). Optimal Allocation for Extreme Value Regression Under Time Censoring. in *Computational and Methodological Statistics and Biostatistics - Essays in Contemporary Advancement* (eds. A. Bekker, D. G. Chen and J. Ferreira), pp. 291-307, Springer Nature, Switzerland. (Annex V)

(5) X. Zhu, H. K. T. Ng (one of the Co-Is) and P. S. Chan. Robust Estimation of Component Reliability Based on System Lifetime Data with Known Signature, submitted to REVSTAT. (Annex VI)

(6) X. Zhu, N. Balakrishnan, Y. Zhou, and H. Y. So (2020). Exact Predictive Likelihood Inference for Laplace Distribution Based on a Time-constrained Experiment, *Communications in Statistics-Simulation and Computation*, 49 (3), 647-668. (Annex VII)

(7) Xin Huang , Hesen Li , Yihua Gu & Ivan S. F. Chan (2020): Predictive Biomarker Identification for Biopharmaceutical Development, Statistics in Biopharmaceutical Research, DOI: 10.1080/19466315.2020.1819404 (Annex VIII)

Papers will be published based on the talk presented at the symposium:

(8) L. Palayangoda and H. K. T. Ng (One of the Co-Is) (2021). Semiparametric and Nonparametric Evaluation of First-Passage Distribution of Bivariate Degradation Processes, *Reliability Engineering and System Safety*, 205, 107230. (Annex IX)

(9) L. Palayangoda and H. K. T. Ng (One of the Co-Is). Nonparametric Approximation Methods for the First-Passage Time Distribution for Degradation Data Measured with Unequal Time Intervals, to appear in *Contributions of Barry C. Arnold to Statistical Science - Theory and Applications* (eds. I. Ghosh, N. Balakrishnan and H. K. T. Ng), Springer Series in Statistical Texts. (Annex X)

7.2   Research collaboration achieved
        (Please give details on the achievement and its relevant impact)
        Research proposals funded after the symposium which are related to the topic of the symposium:
        (1) 2020-2021 Statistical Models and Algorithms for Assessing Robustness and Reliability of Networks with Applications in Cyber Insurance (funded by Casualty Actuarial Society; amount: $16,000; role: Principal Investigator)
        (2) 2020-2025 Modeling and Analysis of System- and Network-based Reliability and Degradation Data (funded by Simons Foundation Collaboration Grants for Mathematicians; amount: US$42,000; Role: Principal Investigator)
        (3) 2021-2024 Statistical Inference and Manifold Structure of Degradation Data by Using the F-divergence (funded by National Natural Science Foundation of China; amount: 500,000CNY; Role: Research Team Member (PI: Fode Zhang))

7.3   Any new development and/or challenging research topic(s) has / have been identified and any new initiative(s) for future research has / have been inspired.
        (1) System and network reliability analysis based on complete and incomplete data
        (2) Degradation and reliability analysis for Li-ion battery

8. **The Layman's Summary**
    (Describe <u>in layman's language</u> the nature, significance and value of the research activities, in no more than 200 words)

Reliability plays an important role in a system. Statistical modeling provides frameworks for extracting useful information and evaluating risk from industrial studies to reduce the failure rate of a system. Reliability theory and its statistical methods are fundamental within industrial statistics modeling and hence many circumstances in our daily life. Topics in Industrial Statistics, including Design of Experiments, Statistical Process Control and Reliability Modeling, will also be discussed.

The symposium aims to provide a platform for knowledge exchange for local and overseas researchers in reliability, validity and risk management, which are closely related to industrial statistics and their applications.

Part C: Research Output

9. **Recognized Conference(s) Paper(s) Related To This Project Was / Were Delivered** *(As Applicable)*
    (Please attach a copy of each conference abstract)

Month / Year / Place	Title	Conference Name	Submitted to RGC *(indicate the year ending of the relevant progress report)*	Attached to this Report *(Yes or No)*	Acknowledged the Support of RGC *(Yes or No)*
N/A	N/A	N/A	N/A	N/A	N/A

10. **Research Personnel Trained** *(As Applicable)*

Name	Capacity
N/A	N/A

11. **Other Impact** *(As Applicable)*
    (e.g. prizes, collaboration with other research institutions, technology transfer, etc.)

    N/A

12. **Statistics on Research Outputs**

	Peer-reviewed Journal Publications	Conference Papers	Scholarly Books, Monographs and Chapters	Patents Awarded	Other Research Outputs (please specify)	
No. of outputs arising directly from this project	6 published & 1 under review	N/A	2	N/A	Type	No.
					N/A	N/A

13. Public Access Of Completion Report

(Please specify the information, if any, that cannot be provided for public access and give the reasons.)

Information that Cannot Be Provided for Public Access	Reasons
N/A	N/A