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Research Assessment Exercise 2020
Impact Overview Statement

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University: The Hong Kong University of Science and Technology
Unit of Assessment (UoA): 11- Mathematics & Statistics
Total number of eligible staff of the university in the UoA: 41

(1)   Context

This UoA comprises the Department of Mathematics in the School of Science. On-going over the review period, we have delivered *public policy, environmental,* and *societal impact* through a long-established science-to-policy research approach that involves collaboration, close engagement, and sharing of data and research findings with government departments in Hong Kong and mainland China. During the review period, the Unit has also widened its user reach and impact by building up and leveraging our faculty's expertise in applied mathematics, data science, and statistics, including computational math, leading to *economic impact* through expanded engagement with industry via partnerships and consultancies, including *health*-related firms, and UoA-linked start-ups.

• **Main types of impacts**

   Public policy and society: e.g. improved public services through publicly available government air quality health index based on UoA research (Fung – case).

   Environment: e.g. enhanced protection and solution-building through new monitoring methodologies for hypoxia in Hong Kong waters (Gan – case).

   Economy and health: e.g. innovation-related business and job opportunities, such as the launch of robo AI-based advisory fintech platform (D Huang [PhD]: Magnum Research Ltd); service and customer growth, and impact on customers' health-related behaviors (Yang: WeGene – case).

• **Major non-academic users and beneficiaries**

   Government agencies, including the HKSAR Government's Environmental Protection Department (EPD), Hong Kong Observatory (HKO), and Agriculture, Fisheries and Conservation Department (AFCD), private companies and their clients, practitioners, and the public.

(2)   Approach to impact

We view societal impact as an essential way to put advanced mathematical concepts to practical use on behalf of the wider community and believe mathematics is capable of generating impact on an extremely wide range of beneficiaries in many different areas. It is also a valuable means to build understanding among users and beneficiaries of the significant role that mathematics researchers play in technological advancement as well as improved quality of life.

   Over RAE2020, UoA initial contacts with potential non-academic users and beneficiaries have been established through diverse mechanisms, including:

   i) Networking through hosting conferences and workshops involving representatives from government departments and industry (e.g. The 5th International Symposium on Regional Air Quality Improvement in Rapidly Developing Economic Regions, Nov 2017);

   ii) Attendance at industry forums/workshops, where faculty learn of challenges facing businesses and share findings, creating openings for projects of mutual interest and joint labs (e.g. HKUST-Sinovation Ventures' Computer Perception and Intelligent Control Lab [est. March 2019]).

   iii) Faculty initiative to establish innovative working partnerships with companies/ organizations, such as joint PhD supervision of theses with industrial components (e.g. with Huawei Technologies Co. Ltd), facilitating knowledge exchange and relationships where on-going research or expertise could assist business development and vice versa.

   Additional ways to broaden our impact include:

   iv) Advancing entrepreneurship by leveraging HKUST's technology transfer infrastructure, IP protection services, and entrepreneurship programs and support to license innovative technologies to industry and found startups: (e.g. Magnum Research Ltd. [AQUMON, an AI based investment advisory platform developed by Magnum Research Ltd, which employs over 80 people]).

v) <u>Unit policies</u> to encourage colleagues to explore impact openings, including a) *recruitment to build strength* in areas of growing societal impact, such as data analysis (e.g. J Cai, Y Yao); b) *allocations* from the Department Development Fund (a discretionary fund from our self-financed MSc programs) to facilitate impact-oriented research activities; c) *inclusion of impact in our evaluation system* for annual salary review as an item of faculty contribution to service; d) *initiation and engagement in University multidisciplinary research institutes and platforms* that foster *interaction with non-academic users* (e.g. Y Wang, JF Cai – HKUST Big Data Institute).

(3)   Strategy and plans
The Unit's research impact will continue to be implemented and expanded in line with the above goals and mechanisms in several ways:

(a) **<u>Strategic hiring:</u>** In faculty recruitment, the Unit will seek to maintain a balance among different research areas, but also to respond to external changes that constantly require us to reassess our direction to remain in alignment with society's evolving needs. For example, our expansion during the review period of applied mathematicians and statisticians through (non-replacement) new hiring of six faculty members, including T Zhang (artificial intelligence and data science), who has deep industrial experience at IBM, Yahoo, Baidu, and Tencent, and was hired as a full professor.

(b) **<u>Industry partnerships:</u>** We will continue to expand our collaborations with industry as exampled by i) the Computer Perception and Intelligent Control Lab (directed by T Zhang), which will pursue technology transfer through collaboration with Sinovation Ventures as well as cutting-edge research and development in artificial intelligence; ii) the Health Data Analytics Lab, established in November 2018 (directed by C Yang) with a HK$1M donation from o2o Space (http://www.spacehk.hk/), which has the health industry as one area of focus; and iii) a collaboration with WeGene (signed March 2019), leading to Math PhD student funding and a successful Innovation and Technology Commission proposal (project starts March 2020) on the development of statistical and machine learning methods for large-scale genomic data analysis. Besides C Yang, six other UoA colleagues will participate in the project.

(c) **<u>Strengthening public communication and outreach:</u>** The Unit plans to build up public engagement activities to create wider knowledge of mathematics' impact on different aspects of society, with high school students being our primary target.

(4)   Relationship to case
Our three impact cases individually exemplify the Unit's diverse approaches to delivery of impact: (i) In the <u>Fung case</u>, *networking* through hosting conferences/workshops, attended by government agencies (EPD, HKO, AFCD), led to agreement on data sharing between government departments and our air quality research group, including real-time data collected by the government and computational model predictions made by our research group. The large volume of data from EPD allowed extensive use and continuous refinement of our model, which further helped improve EPD's model "PATH" for daily forecasting for an air quality health index in Hong Kong, now easily accessible and widely used by the general public. (ii) The <u>Gan case</u> shows how *faculty took the initiative* to raise findings with relevant government agencies (AFCD, EPD, HKO), based on research indicating a large-scale trend of hypoxia in Hong Kong and adjacent waters. Further communication, exchange, and understanding were established through hosting symposia and inviting government representatives to attend. Meanwhile, research data being collected by the five-year 2016/17 OCEAN-HK project is providing evidence and assisting policy formulation of potential solutions, with such synergy between research efforts and public policy-making leading to better environmental protection in Hong Kong. (iii) In the <u>Yang case</u>, *industry interaction* paved the way to a *fruitful long-term research partnership* with private company WeGene, leading to a large increase in the firm's customers and enhanced quality of its provision in the growing commercial area of personal genetic services.