Research Assessment Exercise 2020
Impact Overview Statement
University: The Hong Kong Polytechnic University (PolyU)
Unit of Assessment (UoA): 11 Mathematics and Statistics
Total number of eligible staff of the university in the UoA: 28

(1) Context

Our unit has a long history of proactive engagement with end-users outside academia. Our primary pathway to impact is through direct collaboration with *industry, including finance, retail, electronic, manufacturing and health care*; and *government and public sectors in Hong Kong and mainland China*. Our main beneficiaries are companies, government agencies, policymakers, and the public. We enhance and support company research by explaining processes and helping to reduce production costs and facilitating product development as well as processes and algorithms. We advise on new public policies; and increase public engagement with the mathematical sciences.

(2) Approach to impact

Actively engaging with end users to stimulate interactions outside academia, we welcome new challenges, problems and ideas. Our approach entails:

2.1 Developing new links with users - Using our ***alumni network,*** we actively seek new impact opportunities, organizing events where alumni share industry challenges and company visits to discuss potential research collaborations, such as with China Mobile, Ocean Park etc. Our ***mentorship scheme*** pairs students with experienced industry mentors and hosts events such as annual orientation gatherings, career talks and sharing sessions giving our staff many opportunities to liaise with professionals and increase their awareness of non-academic user needs. These approaches have stimulated research projects, e.g. an *HK Govt. Innovation Technology Fund* supported project with *Frontier Research and Technology Ltd* in 2016 to collaborate on data analytics in high frequency trading.

2.2 Undertaking consultancy and building relationships - Our *Statistical Advisory Unit* (StatAU), a statistical consultancy and advisory services platform managed by our academic staff, completed 36 projects during this RAE period. Consultancy is a route to developing collaborative research projects, such as with *Value Exchange International Ltd* for whom we completed a data analytics consultancy contract on 7-11 store transaction data, followed by 2 collaborative research projects (2016, 2017) on retail data analytics and on logistics for disabled people respectively.

2.3 Providing support and facilities for impact-generating activity – Our new *University Research Facility in Big Data Analytics* (UBDA) (*see Enviro OS*) attracts many non-academic users, and provides a launch pad for research collaborations (e.g. an online data mining project with the *HK Consumer Council* in 2019). Our faculty office and central university services, such as the *Innovation and Technology Development Office* (ITDO), and *Institute for Entrepreneurship* (IfE), foster entrepreneurship and support our students and staff to commercialise their research. Faculty and ITDO business links are used to establish introductions with global businesses such as *Huawei*, *Esquel, Avalon Genomics* and *Biel*, leading to collaborative research projects such as 2 projects with Huawei, and 2 with Esquel (see Case Study). IfE seed-funding and training helped one of our graduates to launch a new modelling business for engineering companies in July 2019. We are conducting collaborative research with that start-up. We also encourage our colleagues to develop software (8 currently available for free download) and obtain patents (one patent granted in 2015).

2.4 Supporting public engagement and improving maths education – A major focus of our public engagement is supporting secondary and tertiary teachers to improve math and science (STEM) education. In March 2018, we launched *YoTeach!*, one of 13 apps developed through the collaboration we lead with 3 other HK universities, to support STEM subject teachers. *YoTeach!* is an active-learning backchannel chat app employing machine learning for symbol and maths hand-writing recognition. Popular worldwide, it currently has over 17,000 users per month and has won 4 international awards in 2019 (3 from *Edutech Asia Awards*, 1 from European *e-Learning Excellence*

Awards). We continuously develop and grow the app through closely working with HK secondary school teachers. We also encourage our staff to conduct public engagement activities such as public lectures (e.g. with the *HK Space Museum*, and as part of the '*Women of our Time' Conference*).We have given 12 mini applied maths lectures to over 900 secondary students in the past 2 years.

2.5 Finding new partners through interdisciplinary links - Interdisciplinary collaborations enable us to tackle societal and industrial challenges and create new links with non-academic partners. Examples include Yiu's Glaucoma detection research for *Hong Kong Eye Hospital,* and Sun's research on public safety engineering projects for the *Yangtze Delta Region Research Institute*. We have successfully encouraged interdisciplinary research within PolyU through cross-departmental seminars. Our sister departments' strong industry relationships enable further collaborations and partnerships (e.g. Wong is working with *Avalon Genomics,* a Biology department partner, on predicting diseases using genomic statistical analysis). We are partners in PolyU's successful 2019 bid to create a HK$208M *Artificial Intelligence Design Lab* in the *HK Science Park,* and will contribute our know-how in *Artificial Intelligence and Statistical Learning techniques* to support work impacting health care, hospitality, and textiles.

(3) Strategy and plans

Over the next 6 years we will broaden and strengthen our research impact by focusing on the following priorities, each of which encourages or supports culture change:

3.1 Strategic research themes: we are aligning our research with key government priorities: focusing on ***Fintech*** and ***statistical machine learning*** to address industry challenges. Prof Sun, recruited in 2018 as chair Professor and Department Head, brings extensive industry connections and experience and has contributed significantly to the development of optimization software for Fintech applications. The appointment of Prof Huang as chair Professor in Statistics in 2017 has enabled us to build a strong statistical machine learning team. Our chair professors will lead by example, fostering a culture of engaging with industry in these strategic areas.

3.2 Using our facilities to build new relationships: our new *UBDA* facility is a focal point for establishing new interdisciplinary relationships. We have just recruited 3 UBDA research fellows for the facility as liaison agents to help initiate new collaborative projects and follow up on new developments. Also, in the past year, we have employed a full-time staff member dedicated to managing StatAU and seeking new partnerships. Utilising PolyU's *Shenzhen base Institute* and our *CAS AMSS-PolyU Joint Laboratory of Applied Mathematics* to facilitate our development in the Greater Bay Area, we will organize workshops for industry to attend and present their business problems.Through our Shenzhen connection, colleagues have been visiting Greater Bay Area (GBA) companies and government bodies (such as *Shenzhen CDC)* to open up new research collaborations and we will continue to grow and develop relationships in this way.

3.3 Rewarding and recognizing staff: we regularly publish newsletters to connect with alumni and outside parties as well as to announce and celebrate our successful projects (e.g. when new collaborations are established). In order to foster culture change around industry engagement, we will roll out seed money for industry collaborations, provide additional research money for staff undertaking industrial projects as well as recognize and reward impact activities in annual appraisals.

(4) Relationship to case studies

The 2 cases illustrate our success in our different approaches and strategies for generating impact. Our *manufacturing efficiency* case demonstrates how our support for staff whose research has impact potential (**2.3**) has had concrete results. Exploiting faculty links to establish a company introduction with *Esquel,* we successfully addressed a serious efficiency challenge for them. Our *infectious disease modelling* case is early evidence of our success in our strategy of using our GBA links to build relationships with organisations based there (**3.2**). As part of a cross-discipline visit, we met with *Shenzhen Centre for Disease Control and Prevention* and identified opportunities where mathematical modelling could aid their policy-making.