DESIGN BRIEF
01.020 DESIGN THINKING PROJECT III
TERM 3 2022

FACULTY TEAM

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SINGAPORE UNIVERSITY OF TECHNOLOGY AND DESIGN

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01.020 DESIGN THINKING PROJECT III
TERM 3 2021

COMMOM THEME

"SOLUTIONS FOR DISASTER MANAGEMENT (i.e. Solutions for food security)"

10.020 Data Driven World	10.022 Modelling Uncertainty	2.003 Understanding Behaviour, Culture & Society

PROGRESSIVE LEARNING

TERM 1 DESIGN BRIEF 1	→	TERM 2 DESIGN BRIEF 2	→	TERM 3 DESIGN BRIEF 3
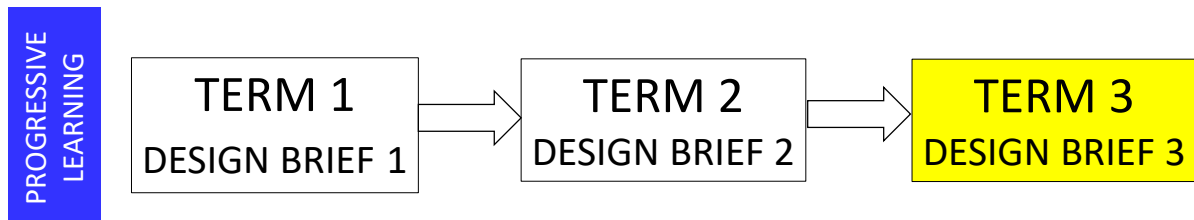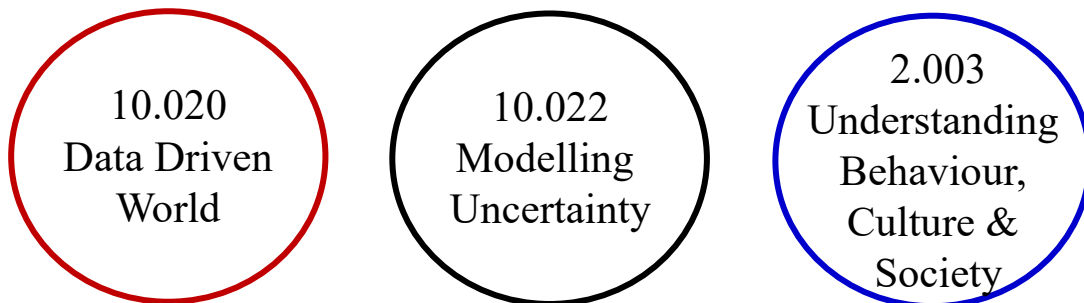
DIGITAL TOOL   FIELDS OF APPLICATIONS

AREAS OF IMPACT

HEALTHCARE
CITIES
AVIATION
DATA SCIENCE
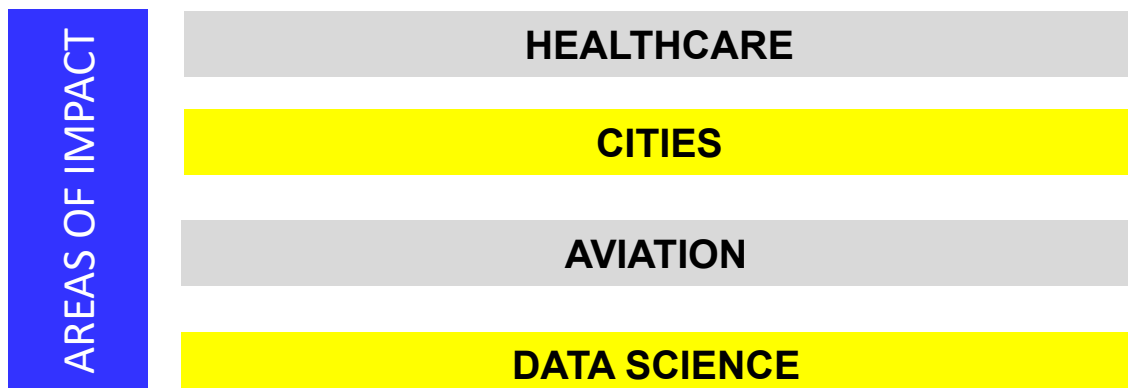
1. Design Thinking Project Title

Modelling Food Safety and Food Security using *Excel* and *Python* language programming

2. Design Thinking Project Learning Objectives

By the end of the project, students should be able to:

10.020 Data Driven World	10.022 Modelling Uncertainty	2.003 Understanding Behaviour, Culture & Society
1. Use plots and visualization to understand data. 2. Transform data for multiple linear regression. 3. Build multiple linear regression model or logistic regression model. 4. Evaluate model using some metrics	1. Develop and evaluate simple probabilistic models for a variety of situations. 2. Examine data, and use tools to visualize data and uncover relationships. 3. Build regression models and estimate their parameters	1. Identify and evaluate one or more social concern (broadly defined) that stems from the design solution you propose for your Term 3 elective's Design Thinking project using a concept (or concepts), theoretical framework, or method from the course.

3. Design Thinking Project Grading

The total score for the Design Thinking Project III will be applied across the three subjects. For instance, if you score 90% in the project, then that score will be applied to the 2D component for all three subjects.

Subject	Weightage, %	Tasks
02.003 Understanding Behaviour, Culture & Society	20	Task 1
10.022 Modelling Uncertainty	20	Task 2
10.020 Data Driven World	60	Task 3
	100	

4. Design Thinking Project Overview

The Design Thinking Project III is a project across three subjects, and this project is being led by the elective 10.020 Data Driven World. In this project, students are expected to cohesively apply knowledge learnt in 10.020 Data Driven World, 10.022 Modelling Uncertainty, and 2.003 Understanding Behaviour, Culture & Society.

In this project, students are given a specific scenario to an open-ended problem to design (discover, define, develop and delivery phases, from the UK Design Council Double Diamond design thinking framework) a solution by applying technical domain knowledge, skills, methods, and attitudes and behaviours associated with design.

5. Design Thinking Project Tasks

United Nation and World Health Organization are forming a common taskforce together with industry leaders to address issues related Food Safety and Food Security. These organizations are looking into using data-driven modelling in order to help them solve some of the challenges in these areas.

More about Food Safety and Security from the following links:
- https://en.wikipedia.org/wiki/Food_safety
- https://en.wikipedia.org/wiki/Food_security

Task 1: Choose and apply an appropriate concept, method, or theoretical framework from 02.003 to address "Modelling Food Safety and Food Security using *Excel* and *Python* language programming." You may analyse the terms of the given problem, your chosen solution and its possible effects, or the method you plan to employ. The table below presents a set of questions that you may use as a step-by-step guide to complete this task. <u>You may also choose other ways of guiding your work.</u>

No.	Guiding Questions
1	Reflect on your design task of modelling food safety and food security.
2	What are a few social concerns related to this design task? Choose one to analyze.
3	What concept(s) from 2.003 might be useful for analyzing the social concern you have chosen?
4	Why did you choose this concept(s) in question 3?
5	What alternative concept(s) did you consider? Why did you decide not to choose this concept?
6	What insight does the concept provide related to the social concern you have identified?

Tasks 2 and 3:
In the following description Task 2 refers to Modelling of Uncertainty deliverables while Task 3 refers to Data Driven World deliverables.

Your goal here is to explore food safety and security using *Multiple Linear Regression*, done in *Excel* and *Python*. This task is open-ended. You are free to find and define a problem (apply the *discovery* and *define* phases first, from the UK Design Council Double Diamond Design Thinking Framework, introduced in 3.007 Design Thinking and Innovation) of your interest related to Food Safety and Security. some possible ideas include:
- Find data for various countries and correlate their socio-economic indicators (such as the Human Development Index as well as other indices) with food security indicators (e.g., the food price index).
- For various countries, regions, or food types, attempt to predict crop yield based on environmental predictors, such as rainfall, average temperature, vegetation cover, drought or flood, etc.

- Using data from around the world, find a model relating various man-made factors (such as warfare and other man-made disasters, agricultural practices, transportation and storage costs, etc) to food price or availability.

As a general guide, you may need to undertake the following actions:
- Identify a problem regarding food security and safety that interests you, and which you want to solve using Multiple Linear Regression **(please check with your instructors first on whether the problem makes sense).**
- Apply Design Thinking in scoping your problem statement (Define phase in the first diamond).
    - <u>Brainstorm</u> different ideas for the problem statement that you went through with your team and how you finally scope it down (*define phase*) it to the selected chosen problem statement. Read some brainstorming techniques[1].
    - <u>Create *personas*</u> to illustrate the pain points of the users in framing the problem statement. Read how you can create personas for data analytics tasks[2].
- Write your problem statement using "How might we" statement[3]. Since this is a Machine Learning task, your statement might be something like: 'how might we predict…'
- Find data related to the problem. The data should span various regions or various points in time. (To get meaningful analysis, take 'various' to be at least 30; more would be better). You are free to choose which datasets to use. Many useful dataset can be found in, for instance, https://www.fao.org/faostat/en/#home and https://www.kaggle.com/datasets .
- Use charts to visualize, summarize and understand your data.
- At this juncture, you will need to do differently for Modelling Uncertainty and Data Driven World deliverables.
    - **Task 2 Specifics** - Modelling Uncertainty guidelines:
        - Identify the response (dependent) variable, and research for appropriate predictor variables – some irrelevant predictor variables may be dropped from your dataset, some predictor variables may require you to look up more data.
        - Build a multiple linear regression model, and measure the accuracy of your model, using an appropriately chosen metric (hint: r^2 is *not* a good metric for this task).
        - If needed, improve your model by incorporating other predictors, and/or removing existing ones.
        - Discuss your data sets, model, accuracy, what metrics you used to judge the accuracy, as well as any insights, predictions or recommendations you can draw from your model.
        - For this task, **you may only use *Excel*,** and not Python.
    - **Task 3 Specifics** - Data Driven World guidelines:
        - Create training and test data sets.
        - Build your model.
        - Choose an appropriate metric to evaluate your model (you may use the same metric as the one used in Modelling Uncertainty part).
        - Improve your model.

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[1] https://www.sessionlab.com/blog/brainstorming-techniques/
[2] https://towardsdatascience.com/how-data-driven-companies-build-customer-personas-c1559d82a1d4
[3] https://conceptboard.com/blog/how-might-we-template/#How_Might_We_questions

- The following technical/tool constraint applies: you are **NOT** allowed to use Neural Networks or other Machine Learning models. You **must use Python** and Jupyter Notebook.

6. Design Thinking Project Deliverables

All three tasks are due in Week 11 (Friday by 11:00PM).

For Task 1, produce a set of PowerPoint slides that summarizes your analysis. Other presentation applications, like Prezi, may be used as well. Discuss your slides in a short 8-minute oral presentation during **Week 11 in your recitation section.** All team members are required to present. Submit your presentation in either pdf or ppt. (if video is used) format on eDimension **under '2022 September Term - 01.020: Design Thinking Project III'** course.

For Task 2, Submit their work for through eDimension at the 01.020 Design Thinking Project III webpage. The submission should consist of a PDF report limited to 5 pages, and an implementation of the final multiple linear regression model in *Excel*. The *Excel* spreadsheet needs to be annotated, interactive (i.e. contains formulas, so that changing the data input results in different output), and contain the raw datasets used.

For Task 3, Submit their work for through *Vocareum Assignment* and *eDimension* submission. The submission should use the template provided in Vocareum and must contain the following:
- 7-min video presentation of your work. This is to be submitted on eDimension.
- All data files
- In addition, the Jupyter notebook should contain the following:
  - Names of the group members, and a short sentence summarizing each member's contribution.
  - Problem Statement
    - Background description of the problem
    - User Persona
    - Problem Statement using "how might we ..." statement
  - Data
    - Link to data sources
    - Discussion on why these data were used, including any relevant visualizations
    - Code and steps to clean the data
  - Model
    - Discussion on the predictors or features
    - Code and discussion on building the model
    - Any other relevant mathematical details
  - Model Evaluation
    - Discussion on the chosen metric to evaluate your final model, how that model compares with your earlier attempts, any mathematical details, and all resources consulted
    - Code and results of the metric on your test data set
  - Discussion of the result
  - Discussion of your code and steps taken to improve the accuracy of your model

Students must **export the Jupyter notebook into a PDF file and upload it on eDimension under '2022 September Term - 01.020: Design Thinking Project III'** course.

6. Design Thinking Project Budget
No budget is allocated for this project.

7. **Design Thinking Project Rubrics**

Rubrics provide a set of expectations for the students and hence serve as a guidance for the accomplishment of the design thinking project successfully.

01.020 Design Thinking Project III - 2022
2.003 Understanding behaviour, Culture & Society – **Rubrics for Presentation**
Cohort _____   Group No_____

Criterion (Weightage)	Design Skills	Design deliverables (Expectations for Student Score)			Score
		Below Expectations (0-2)	Meets Exp. (3-4)	Exceeds Exp. (5)	
Comprehension **Informed** (5%)	Cognitive Restructuring	Selection of concept, method, or reading is not appropriate and incorrectly interpreted	Selection of concept, method, or reading is appropriate and generally correctly interpreted	Selection of concept, method, or reading is appropriate, accurately interpreted, and supported through textual analysis	
Critical Thought **Insightful** (10%)	Problem Formulation	Analysis of the social dimensions of the effects of chosen design solution is shallow or non-existent	Analysis of the social dimensions of the effects of chosen design solution is generally adequate, pointing out key issues of concern	Analysis of the effects of chosen design solution is incisive, offering novel ways to think about society, design, and technology, and is supported with appropriate evidence	
Rhetoric **Clarity** (5%)	Technical Comm.	The presentation is unclear and unconvincing.	The presentation is generally clear, slides are organized, and ideas are communicated adequately	The presentation is clear, slides are well-organized, and ideas are presented concisely and accurately	
				Total Score (Max 20 pts)	

01.020 Design Thinking Project III - 2022
10.020 Data Driven World – **Rubrics for Video and Jupyter Notebook**
Cohort _____   Group No_____

Criterion	Design Skills	Design deliverables (Expectations for Student Score)			Score
		Below Exp. (0-1)	Meets Exp. (2-3)	Exceeds Exp. (4-5)	
Problem Statement	-Conceptual Thinking -Critical Thinking -Imagination and Exploration -Decision Making	The problem statement is incoherent.	The problem statement is lacking one or more of the following: clarity in its definition, relevance, and the design opportunity.	The problem statement clearly defines the problem, its relevance, and the design opportunity.	
Dataset Choice and Data Preparation	-Data Analysis & Interpretation -Visualization, -Sense Making	Students did not choose an appropriate dataset. The number of data is lacking. The dataset is not cleaned up. The proportion of the training and the test set are not appropriate. Data is not described nor visualized.	Students chose an appropriate dataset. Students may not do the necessary clean up or preparation and just use the data as it is. Students may not split the data in the right proportion. Data are visualized.	Students chose an appropriate dataset with a suitable amount of data. Students did the necessary clean up and preparation. Students split the data for training and test in a right proportion. Description of the dataset is clear and the sources are properly cited. Data are visualized and analyzed to give superior understanding.	
Model and Evaluation	-Problem Solving -Sense Making -Digital Fluency -Trend Forecasting	Students do not use an appropriate model nor appropriate metrics. No discussion or analysis is found.	Students use an appropriate model for the data and appropriate metrics to evaluate the model. The discussion and analysis on the model and the metrics are lacking.	Students use an appropriate model for the data and appropriate metrics to evaluate the model. Students discuss and analyse the model and the metrics in great depth.	
Improvements (Iteration)	-Problem Solving -Sense Making	Students do not attempt to improve the model's accuracy.	Students show modest improvement to the accuracy of the model through some modification to the parameters or the dataset.	Students are able to show significant improvements in the accuracy of the model by using various fine tuning or better data preparation. Students are able to discuss the improvement gained.	
Sustainability (Durability of code)	-Communication	Students do not write code in a modular way. The code is not documented or properly commented. The code is difficult to understand.	Students write code in a modular way. The code is documented and commented.	Students write code in a modular way. The code is properly documented and commented. The code can be easily understood by other programmers.	
				Total Score (Max 25 pts)	
Criterion	Design Skills	Below Exp. (0-1)	Meets Exp. (2)	**Exceeds Exp (3)**	Score
Webpage (BONUS)	-Digital Prototyping -Interaction Design Practice -User Experience Design -User Testing & Usability	Webpage is somewhat functional and/or displays a poor user interface and provides a poor user experience.	Webpage is functional but lacks important features for a good user interface and user experience.	Webpage is fully functional and provides a superior user interface and gratifying user experience.	
				Total Score after Bonus (Max 28 pts)	

01.020 Design Thinking Project III - 2022

10.022 Modelling Uncertainty – **Rubrics for Report**

Cohort _____   Group No_____

Criterion	Design Skills	Design deliverables (Expectations for Student Score)			Score
		Below Exp. (0-2)	Meets Exp. (3-4)	Exceeds Exp. (5)	
Dataset Choice and Data Preparation	Analysing, interpretating & using quantitative data Communicating through 2D visuals/graphically/ pictorially	Students did not choose an appropriate dataset. The number of data is lacking. The dataset is not cleaned up. Data is not described nor visualized.	Students chose an appropriate dataset. Students may not do the necessary clean up or preparation and just use the data as it is. Data are visualized.	Students chose an appropriate dataset with a suitable amount of data. Students did the necessary clean up and preparation. description of the dataset is clear and the sources are properly cited. Data are visualized and analyzed to give superior understanding.	
Model and Evaluation	Constructing visual representations of data	Students do not use an appropriate model nor appropriate metrics. No discussion or analysis is found.	Students use an appropriate model for the data and appropriate metrics to evaluate the model. The discussion and analysis on the model and the metrics are lacking.	Students use an appropriate model for the data and appropriate metrics to evaluate the model. Students discuss and analyse the model and the metrics in great depth.	
Improvements (Iteration)	Iterating & improving the solution	Students do not attempt to improve the model's accuracy.	Students show modest improvement to the accuracy of the model through some modification to the parameters or the dataset.	Students show significant improvements in the accuracy of the model by using various fine tuning or better data preparation. Students are able to discuss the improvement gained.	
				Total Score (Max 15 pts)	