UN environment programme | finance initiative

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Sustainability Risk in Retail Banking

Assessing Physical Risks

June 2021

JC3 Joint Committee on Climate Change

“Changes in climate policies, new technologies and growing physical risks will prompt reassessments of the values of virtually every financial asset. Firms that align their business models to the transition to a net zero world will be rewarded handsomely. Those that fail to adapt will cease to exist.”

– Mark Carney, Chair of the Financial Stability Board 2011-2018

CLIMATE IMPACTS FROM PHYSICAL HAZARDS
PHYSICAL RISKS ARE MADE WORSE BY RISING TEMPERATURES

Physical risks

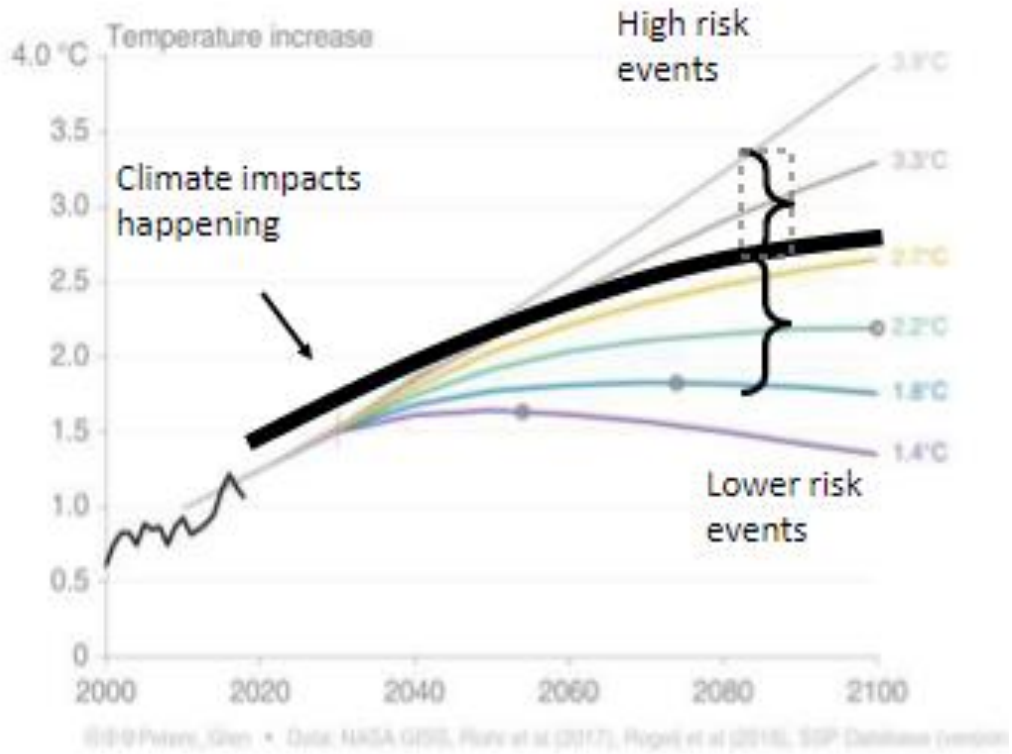
- Driven by changes in the physical systems as a result of climate change

- Incremental risks- long-term changes in baseline conditions as a result of climate change
  - Increasing droughts
  - Desertification
  - Sea-level rises

- Extreme events- short-term events that may be exacerbated or made more common by climate change
  - Heatwaves
  - Hurricanes
  - Fires
  - Floods

Temperature

The higher the temperature rise, the greater the risk of non-linear physical harms



PHYSICAL RISKS-ACUTE HAZARDS AND INCREMENTAL RISKS

CERTAIN PHYSICAL RISKS CAN APPEAR GRADUALLY WHICH ASK THE QUESTION OF ADAPTATION AND RESILIENCY OVER THE LONG RUN

Extreme event example: floods

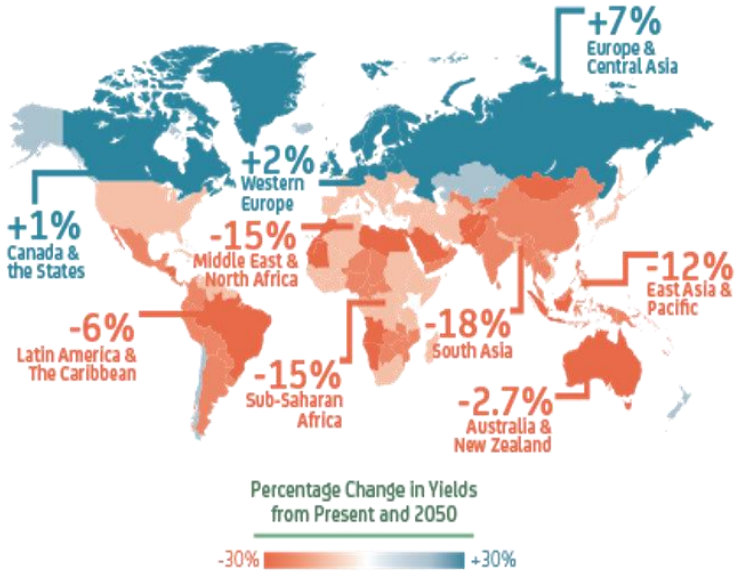
- Floods can arrive extremely fast ("flash floods"), but the conditions in which floods manifest can be predicted with adequate information.
- A large amount of rain, a storm surge, a combination of high tides and high river levels can cause floods.
- In 2014, it was estimated that Malaysia faced $1.3 billion loss from various climate hazards, but largely attributed to flooding[1]
  - Damage from the 2014-15 Malaysia floods alone resulted in losses of up to approx. $300 million[2]

Flood-prone areas in Malaysia[3]

Incremental change example: temperature rise

- Temperature rise can affect agricultural productivity over the long run
- Coupled with an increase in CO2 concentration and crop water use efficiency, certain regions could be severely affected by a decrease in food self-sufficiency

Change in regional crop yields by 2050[4]



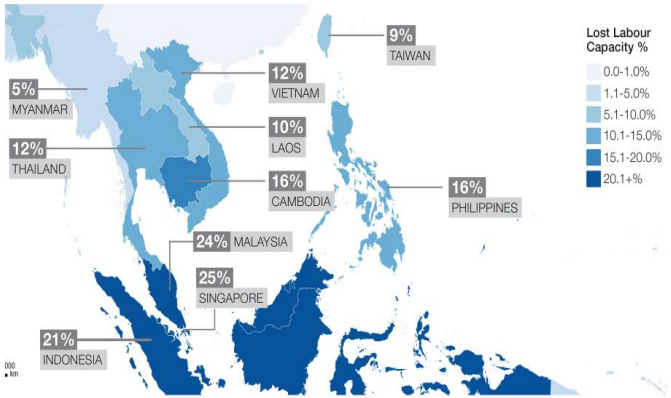
1.World bank
2 Floodlist 2015
3. Ruiz Estrada et al., 2017

4. World Bank

PHYSICAL RISKS IN MALAYSIA
THE COUNTRY IS THREATENED BY VARIOUS CLIMATE DISRUPTIONS

Rising temperature

- A study determined that in some Malaysian cities, temperature has risen by 6.75 degrees from 1998 to 2019[1].
  - The increase in temperature has been linked to climate change and increasing urban development[1].
- It is estimated that heat stress will lead to a 24% reduction in labour capacity by 2045[2].



Rising seas[3]

- 13% of total land area in Malaysia is situated within 5km of a coast (70% of the total population live in coastal areas)
- As a result, sea level rise can have detrimental impacts on the country, for example
  - The coast of Selangor and Batu Pahat has been exposed to 1878.5 ha and 415.47 ha of coastal erosion
  - Coastal flooding in Johar resulted in an estimated economic loss of RM 2.4 billion and damages worth approximately RM 0.35 billion (1USD = 4,13MYR)
  - Research has shown that a one-meter rise in sea level will result in an estimated 180,000 ha loss of agricultural land and the destruction of 15-20% of mangroves situated at the coast

Consequences of flooding

- It is estimated that on average floods cause USD 60,242 million in economic damages annually in Malaysia[4]
- Agricultural, fisheries and forestry sectors are highly vulnerable to flooding risks[4].
  - In 2019, the agriculture sector accounted for 7.1% of Malaysia's GDP[5]
  - An estimated one third of the country's population is dependent on agriculture for their livelihood
- The manufacturing sector is also exposed to flooding risks due to disruptions transportation and decrease in the production capacities[4].
  - The manufacturing sector plays a vital role in economic growth for the country by linking regional and global supplies of exports[4]

1. ThinkCity, 2021
2. Verisk Maplecroft, 2017
3. Sofia Ehsan et al. 2019
4. Shaari et al. 2017
5. Department of Statistics Malaysia 2020

TCFD BANKING PHASE II EXPLORED NEW CLIMATE SCENARIOS AND EMERGING EXPECTATIONS AROUND TCFD DISCLOSURES

39 BANKS ON 6 CONTINENTS WORKED TO EXPAND THEIR CLIMATE RISK TOOLKITS

Climate scenarios

- Explore the spectrum of climate scenarios
- Identify scenario differences and key assumptions
- Learn how to use scenarios to assess risks and opportunities
- Identify relevant internal and comparable reference scenarios

Data and methodology

- Determine availability of climate relevant asset-level data
- Advance and refine phase I methodologies for risk and opportunity assessment
- Create a comprehensive risk taxonomy across sectors and geographies
- Develop best-practices around sector/geographical assessments

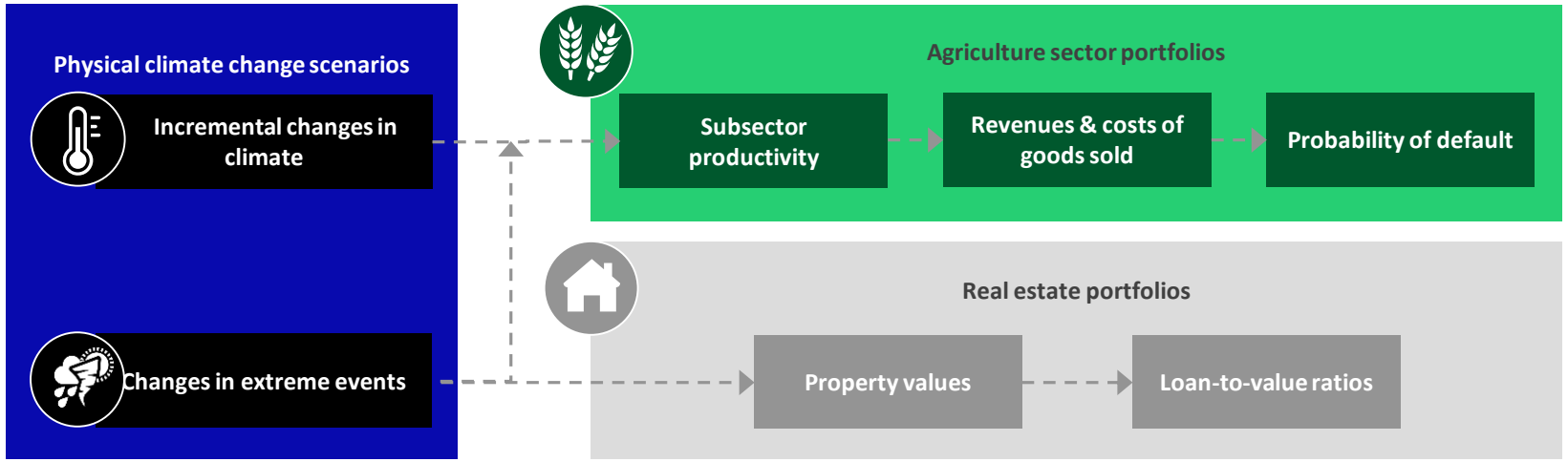
Reporting and governance

- Understand expectations around TCFD disclosures
- Develop approaches to standardize disclosures
- Develop practices for creating an internal climate risk program
- Draft TCFD disclosures

UNEP FI PHYSICAL RISK ASSESSMENT FRAMEWORK

THE PHYSICAL RISK METHODOLOGY COVERS BOTH EXTREME EVENTS AND INCREMENTAL HAZARDS

Overview of the physical risk framework



Agriculture

1. Select representative sample of borrowers to assess
2. Identify climate change impacts on subsector productivity, price, downtime
3. Assess implications for borrowers' finances: changes in revenue & costs of goods sold
4. Estimate changes in probability of default: stress the factors/ratios in banks' internal credit rating models that have revenue and cost components
5. Extrapolate findings to whole portfolio subsector

Real estate

1. Identify properties facing risk of extreme events using existing online risk assessment platforms
2. Estimate probabilities of properties encountering extreme events in future
3. Assess potential changes in property values for 'at risk' properties
4. Calculate revised loan-to-value ratios

UNEP FI'S PHYSICAL RISK WORK: OUTPUTS

TCFD BANKING PROGRAM REPORT 'CHARTING A NEW CLIMATE' PROVIDES A BLUEPRINT FOR PHYSICAL RISK ASSESSMENT

- **Phase II** aimed to help banks make progress on key methodological issues highlighted in phase I
- **Charting a New Climate provides rich technical guidance and resources** to support forward-looking scenario-based assessments of physical risks and opportunities
- The report and pilot were structured as a series of modules
- The modules included in the report were as follows:

1	Extreme events data & portals
2	Portfolio physical risk heatmapping
3	Tools for physical risk assessment of financial risk
4	Physical risk correlation analysis of FI portfolios
5	Analysis of opportunities driven by physical climate risk

EXTREME EVENTS DATA AND PORTALS
DATA CONTINUES TO BE A CHALLENGE FOR GRANULAR PHYSICAL RISK ASSESSMENTS

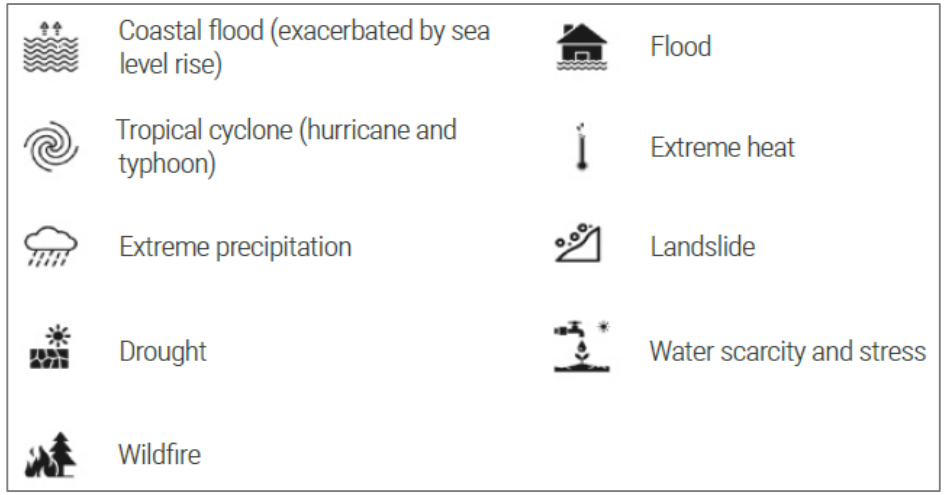
Along with future incremental climate changes, extreme events are some of data layers needed to analyse physical risks in portfolios

Many datasets and portals are now available

Piloting banks evaluated data portals:

- Spatial resolution and coverage
- Output metrics / statistics
- Usability

Variables covered



Framework for review (selected tools shown)

Hazard	Provider – portal / product name	Observed/ Historical	Time periods			Future scenarios			Spatial resolution	Spatial coverage	Outputs		Licensing and cost
			2020/ 2030	2040/ 2050	2100	<2°C	2°C	>4°C			Data	Map	
Coastal flood (exacerbated by sea level rise)	*Climate Central - Coastal Risk Screening Tool[11]		✓	✓	✓	✓	✓	✓	5 m U.S. 30 m excl. U.S.	Global	✓	✓	Free-to-use
	*Climate Central - Surging Seas Risk Finder[12]		✓	✓	✓	✓	✓	✓	5 m	U.S. and Caribbean	✓	✓	Free-to-use
	*Climate Central - Portfolio Analysis Tool (PAT)[13]	✓	✓	✓	✓				Property level	Global	✓	✓	Chargeable
	GFDRR - ThinkHazard![14]	✓	✓						~1 km	Global		✓	Free-to-use
	Jupiter - FloodScore™[15]		✓	✓	✓	✓	✓	✓	3 m	Global	✓	✓	Chargeable
	PREP - PREPdata[16]			✓	✓		✓	✓	2 km	Global	✓	✓	Free-to-use
	WRI - Aqueduct Floods[17]	✓	✓	✓	✓	✓	✓	✓	1 km	Global	✓	✓	Data: chargeable Map: free-to-use

PORTFOLIO PHYSICAL RISK HEATMAPPING

PILOTING BANKS' COMBINED VIEWS OF THE RELATIVE IMPORTANCE OF FOUR VULNERABILITY INDICATORS TO SIX SECTORS AND SUB-SECTORS

Program heatmap

		Vulnerability Indicator scores			
Sector	Sub-sector	Natural resources	Assets & processes	Market demand	Labor health & productivity
Agriculture, forestry & fisheries	Animal raising, production, support activities	3	2	2	2
	Crop growing, production, support activities	3	2	2	3
Metals and mining	Ore mining	3	2	1	3
Power and energy	Hydropower	3	2	2	1
	Solar	1	2	2	1
	Thermal power station	3	2	2	2
	Wind	2	2	2	1
Oil and gas	Extraction of crude petroleum and natural gas	3	2	3	3
	Liquefaction and regasification	3	1	1	1
	Manufacture of refined petroleum products	2	1	1	1
	Oil & natural gas transmission & distribution	1	2	1	1
	Support activities for petroleum and natural gas extraction	1	2	2	2
Manufacturing	Chemical manufacturing	3	2	1	1
	Basic metals and fabricated products	3	2	2	2
Real estate	Commercial property	2	2	3	2
	Residential property	2	1	3	1

Notes

- Piloting banks identified **many cause-effect chains** from changes in climate and climate-related hazards to indicators of investment performance
- Discussions between climate and sector experts within the piloting banks helped to **build shared understanding**
- **Banks gave high vulnerability scores** for:
  - Reliance on **natural resources** (water, land)
  - Climate sensitivity of **market demand**
  - Reliance on **labour health and productivity**

TOOLS FOR PHYSICAL CLIMATE RISK ASSESSMENT OF FINANCIAL RISK

COMMERCIALLY-AVAILABLE TOOLS WERE EVALUATED AGAINST A SERIES OF CRITERIA TO DETERMINE COVERAGE

Assessment framework for tool providers

			Provider[a]							
			427 (1)	427 (2)	ACC	ACC-VE	C4 (1)	C4 (2)	CD	CLIMAFIN	RhG
Scenarios	<2.0°C (RCP 2.6)				✓	✓				✓	✓
	2.0°C (RCP 4.5)				✓	✓	✓	✓		✓	✓
	3.0°C (RCP 6.0)				✓	✓	✓			✓	✓
	>4.0°C (RCP 8.5)		✓	✓	✓	✓	✓	✓	✓	✓	✓
Time horizons	Baseline/historical		✓	✓	✓	✓	✓	✓	✓		✓
	Near-term (2030–2040)		✓	✓	✓	✓				✓	✓
	Medium-term (2050)				✓	✓	✓	✓		✓	✓
	Long-term (2100)						✓	✓	✓	✓	✓
Climate hazards	Chronic changes		✓	✓	✓	✓	✓	✓	✓	✓	✓
	Acute events		✓	✓	✓	✓	✓		✓	✓	✓
Risk analysis	Level of analysis	Asset[a]	✓	✓[1]	✓	✓	✓	✓	✓	✓	✓
		Firm	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Sector	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Country	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Portfolio	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Impact channel	Macroenvironment		✓	✓	✓	✓			✓	✓
		Supply chain		✓	✓	✓	✓			✓	
		Operations and assets	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Markets and customers		✓	✓	✓	✓	✓		✓	✓
	Method	Physical exposure	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Vulnerability indicators		✓	✓		✓	✓			
		Physical impact modeling	✓	✓		✓			✓		✓
		Financial modeling		✓		✓			✓		✓
User inputs	Counterparty name (ISIN code)			✓[2]	✓	✓	✓	✓	✓	✓	✓
	Location		✓		✓	✓		✓	✓	✓	✓
	Value of asset				✓	✓		✓	✓	✓	✓
	Characteristics of asset		✓		✓	✓		✓	✓	✓	✓
Outputs	Semi-quantitative		✓	✓	✓		✓	✓			
	Quantitative			✓		✓		✓	✓	✓	✓
	Non-financial metrics		✓		✓		✓	✓			
	Financial metrics		✓	✓[1]		✓			✓	✓	✓

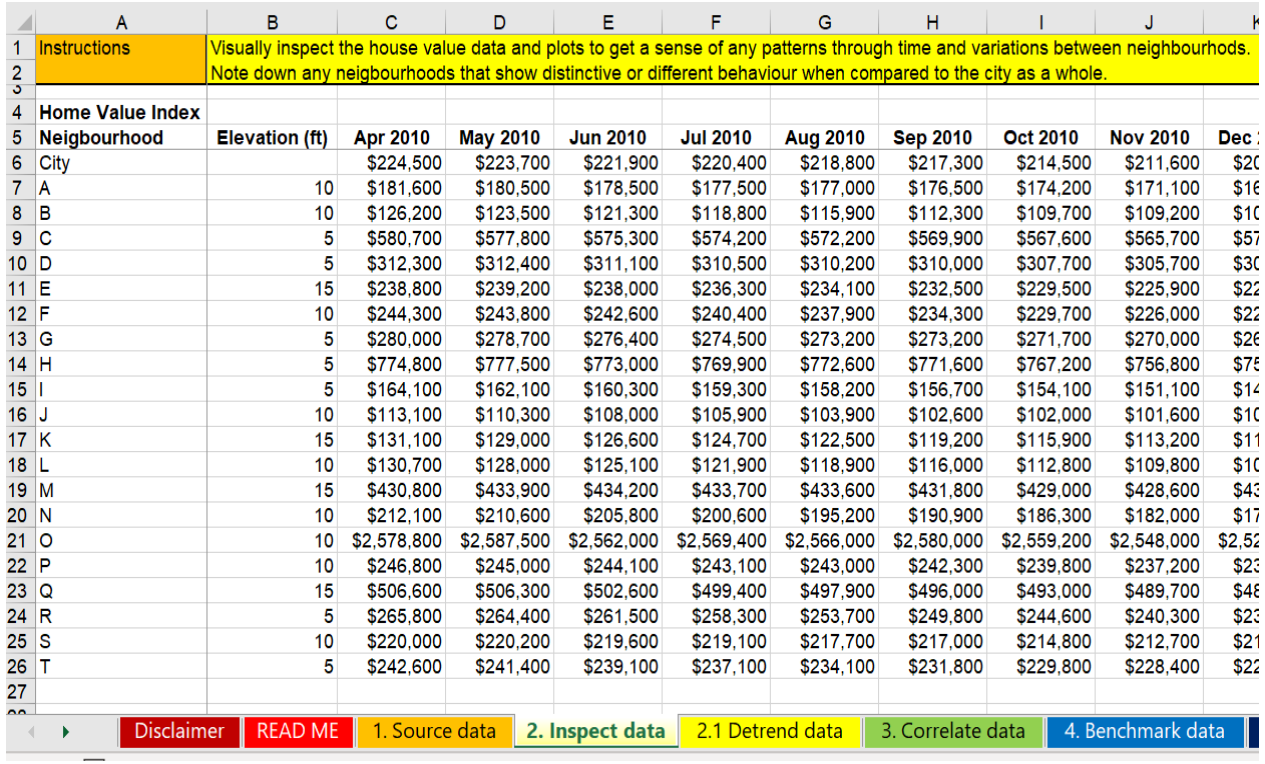
Notes

- **Building a tool for robust quantification of physical risk in financial terms is a large endeavour**
- Commercial tools and analytics are designed for various purposes e.g:
  - Portfolio assessment
  - Security selection / investment appraisal
- They can differ in their approaches to risk analysis:
  - Impact channels covered
  - Methods and approaches for impact assessment

PHYSICAL RISK CORRELATION ANALYSIS OF FI PORTFOLIOS

THE EXERCISE PROVIDED INSTITUTIONS WITH A DEEPER UNDERSTANDING OF THE RELATIONSHIP BETWEEN ASSET VALUES AND EXTREME EVENTS

Step-by-step workflow for correlation exercise



	A	B	C	D	E	F	G	H	I	J	K
1	Instructions	Visually inspect the house value data and plots to get a sense of any patterns through time and variations between neighbourhods.									
2		Note down any neigbourhoods that show distinctive or different behaviour when compared to the city as a whole.									
4	Home Value Index										
5	Neigbourhood	Elevation (ft)	Apr 2010	May 2010	Jun 2010	Jul 2010	Aug 2010	Sep 2010	Oct 2010	Nov 2010	Dec
6	City		$224,500	$223,700	$221,900	$220,400	$218,800	$217,300	$214,500	$211,600	$20
7	A	10	$181,600	$180,500	$178,500	$177,500	$177,000	$176,500	$174,200	$171,100	$16
8	B	10	$126,200	$123,500	$121,300	$118,800	$115,900	$112,300	$109,700	$109,200	$10
9	C	5	$580,700	$577,800	$575,300	$574,200	$572,200	$569,900	$567,600	$565,700	$57
10	D	5	$312,300	$312,400	$311,100	$310,500	$310,200	$310,000	$307,700	$305,700	$30
11	E	15	$238,800	$239,200	$238,000	$236,300	$234,100	$232,500	$229,500	$225,900	$22
12	F	10	$244,300	$243,800	$242,600	$240,400	$237,900	$234,300	$229,700	$226,000	$22
13	G	5	$280,000	$278,700	$276,400	$274,500	$273,200	$273,200	$271,700	$270,000	$26
14	H	5	$774,800	$777,500	$773,000	$769,900	$772,600	$771,600	$767,200	$756,800	$75
15	I	5	$164,100	$162,100	$160,300	$159,300	$158,200	$156,700	$154,100	$151,100	$14
16	J	10	$113,100	$110,300	$108,000	$105,900	$103,900	$102,600	$102,000	$101,600	$10
17	K	15	$131,100	$129,000	$126,600	$124,700	$122,500	$119,200	$115,900	$113,200	$11
18	L	10	$130,700	$128,000	$125,100	$121,900	$118,900	$116,000	$112,800	$109,800	$10
19	M	15	$430,800	$433,900	$434,200	$433,700	$433,600	$431,800	$429,000	$428,600	$43
20	N	10	$212,100	$210,600	$205,800	$200,600	$195,200	$190,900	$186,300	$182,000	$17
21	O	10	$2,578,800	$2,587,500	$2,562,000	$2,569,400	$2,566,000	$2,580,000	$2,559,200	$2,548,000	$2,52
22	P	10	$246,800	$245,000	$244,100	$243,100	$243,000	$242,300	$239,800	$237,200	$23
23	Q	15	$506,600	$506,300	$502,600	$499,400	$497,900	$496,000	$493,000	$489,700	$48
24	R	5	$265,800	$264,400	$261,500	$258,300	$253,700	$249,800	$244,600	$240,300	$23
25	S	10	$220,000	$220,200	$219,600	$219,100	$217,700	$217,000	$214,800	$212,700	$21
26	T	5	$242,600	$241,400	$239,100	$237,100	$234,100	$231,800	$229,800	$228,400	$22
27											

Disclaimer | READ ME | 1. Source data | 2. Inspect data | 2.1 Detrend data | 3. Correlate data | 4. Benchmark data

Activities

- Framework and introduction to correlation analysis and demonstration of climate impact
- Literature review of correlation analysis for the agricultural and real estate sectors
- Development of pilot case studies through data gathering, bilateral and group
- Step-by-step worked example of correlation analysis using an Excel tool