HONG KONG MONETARY AUTHORITY 香港金融管理局		
Supervisory Policy Manual		
IC-5	**Stress-testing**	V.1 – 28.02.03

This module should be read in conjunction with the Introduction and with the Glossary, which contains an explanation of abbreviations and other terms used in this Manual. If reading on-line, click on blue underlined headings to activate hyperlinks to the relevant module.

Purpose

To provide guidance to AIs on the use of stress tests for risk management purposes

Classification

A non-statutory guideline issued by the MA as a guidance note

Previous guidelines superseded

This is a new guideline.

Application

To all AIs

Structure

---

1. Introduction

1.1 Background

1.1.1 Stress-testing involves the use of various techniques to assess a financial institution's potential vulnerability to "stressed" business conditions. Typically, this relates, among other things, to the impact on the institution's profitability and capital adequacy. Stress-testing has played an increasingly important role in the risk management of banks in recent years.

1.1.2 Examples of extreme market movements or crises in the past show that it is inadequate to manage risks only on the basis of "normal" business conditions. When a bank is affected by a severe market shock, it may incur substantial losses as a result of the following:

- assumptions of how markets behave during normal conditions no longer hold true;
- new concentrations of risk emerge through unexpected linkages of different markets;
- rapid price movements and squeeze in liquidity across multiple markets;
- sudden deterioration in the economic conditions of affected countries or regions; and

- difficulties in unwinding or hedging positions during a crisis.

1.1.3 The above illustrates the importance of employing stress-testing techniques to estimate a bank's likely losses under adverse conditions so that it can be better prepared for such situations. Apart from considering the effects of exceptional (but plausible) events, a bank may vary the level of adversity (e.g. by including mildly stressed scenarios[1]) to assess its vulnerability under different situations.

1.1.4 This module provides guidance to AIs on how they could develop their stress-testing capabilities for the purpose of effective risk management. **Examples are given in the module for illustrative purposes. Therefore, the assumptions and figures used in the illustrations should not be construed as forecasts by the HKMA. AIs should determine their own assumptions when conducting the stress tests.**

1.1.5 This module should be read in conjunction with IC-1 "General Risk Management Controls". Criteria on the use of stress tests for specific areas are also contained in the following modules:

- CA-G-3 "Use of Internal Models to Measure Market Risk";
- CR-G-3 "Credit Administration, Measurement and Monitoring";
- CR-G-5 "Country Risk Management";
- CR-G-7 "Collateral and Guarantees";
- CR-G-8 "Large Exposures and Risk Concentrations";
- IR-1 "Interest Rate Risk Management"; and

[1] This is in line with the approach proposed under the New Basel Capital Accord, whereby banks adopting the internal ratings-based approach will be required to conduct credit risk stress tests as a means of ensuring that they hold a capital buffer sufficient to withstand at least the effects of mild recession scenarios (e.g. two consecutive quarters of zero GDP growth).

- LM-1 "Liquidity Risk Management".

1.2 Main functions of stress-testing

1.2.1 Stress-testing is a useful risk management tool for AIs. It has, in particular, the following functions:

- provide a means for estimating an AI's risk exposures under stressed conditions and enable it to develop or choose appropriate strategies for mitigating such risks (e.g. restructuring positions and developing appropriate contingency plans);
- improve an AI's understanding of its own risk profile and facilitate its monitoring of changes in such profile over time;
- allow the Board of Directors and senior management to determine whether an AI's risk exposures correspond to its risk appetite;
- supplement the use of statistical risk measures (e.g. value-at-risk models) which are based mainly on historical data and assumptions. Stress-testing helps to quantify "tail" risk (i.e. the risk of losses under abnormal market conditions) and re-assess modelling assumptions (e.g. those in relation to volatility and correlation);
- evaluate an AI's capacity to withstand stressed situations in terms of profitability and capital adequacy; and
- facilitate the assessment of risk exposures to emerging markets which may be more vulnerable to shocks and crises than developed markets.

1.3 The HKMA's approach to stress-testing

1.3.1 The HKMA believes that stress tests, if properly designed and implemented, will enhance an AI's risk management framework and help the AI to be prepared for difficult market conditions. In addition, AIs of all sizes, regardless of the

level of sophistication of their methods or techniques for conducting stress tests, should be able to derive some benefits from stress-testing.

1.3.2 AIs are therefore expected to integrate stress-testing into their risk management process and conduct stress tests on a regular basis. They should aim to develop a comprehensive stress-testing programme that reflects the specific risk characteristics of their portfolios and document the policies and methodology adopted.

1.3.3 AIs are expected to have in place a stress-testing programme that is appropriate to the nature and complexity of their business activities within one year of the issue date of this module. The HKMA will monitor the progress of AIs in enhancing their stress-testing capabilities in the course of its continuous supervision. AIs with significant or complex business operations should accord special priority to this, if they have not already done so.

1.3.4 Where an AI has developed a stress-testing programme, the HKMA will evaluate the appropriateness and effectiveness of the stress tests conducted during its off-site reviews or on-site examinations.

1.3.5 In reviewing a stress-testing programme, the HKMA will have regard to the following:

- the complexity and level of risks of an AI's activities;
- the adequacy of stress tests (e.g. types of stress scenarios and parameters chosen) employed by the AI in relation to its activities;
- the appropriateness of the assumptions used in the stress tests;
- the capacity of the AI's capital and earnings to absorb potential losses under stressed situations;
- the adequacy of the AI's risk management policies and stress-testing procedures;
- the appropriateness of the AI's level of risk exposures relative to its stated objectives and risk tolerances;

- the adequacy of the AI's contingency planning for actions to be taken should a particular stress scenario happen;
- the level of oversight exercised by the Board and senior management on the stress-testing programme and results generated; and
- the adequacy of the AI's internal review and audit of its stress-testing programme.

1.3.6 The HKMA will review regularly (e.g. once a year) or on a need basis the stress-testing results of an AI, including any actions taken in response to the results generated, and discuss such results with its senior management during prudential meetings.

1.3.7 The HKMA may also request an AI to conduct additional stress tests on those positions where the risk is considered to be significant.

1.3.8 It is generally acceptable for stress tests to be conducted by an AI's head office on a group basis so long as those stress tests can reflect the specific risk characteristics of the AI's portfolios. AIs having such an arrangement should discuss this with the HKMA.

1.3.9 Where appropriate, the HKMA will make use of the data and results generated from AIs' stress tests in its own stress-testing exercise to assess the vulnerabilities and soundness of the Hong Kong banking sector.

2. Stress-testing programme

2.1 Process

2.1.1 AIs should take steps to implement a comprehensive stress-testing programme. At a minimum, the process entails the following:

- review the nature of an AI's portfolios as well as the external environment in which it operates with a view to drawing up a list of major risk factors that should be tested under stress scenarios (see subsection 2.4 below);

- design the stress tests appropriate to an AI's portfolios, including the specification of likely stress events and scenarios (see section 3 below);
- document the assumptions underlying the stress tests and how these are derived (e.g. the assumptions on interest rate movements);
- determine the stress-testing procedures (e.g. the designation of responsibilities and the frequency of stress tests);
- conduct the stress tests regularly and analyse the stress-testing results to identify potential vulnerabilities and risks;
- report the stress-testing results to senior management and relevant business line managers;
- determine the appropriate remedial actions to be taken to address potential risks identified from the stress tests;
- provide the Board of Directors, where appropriate, with a summary report on the stress-testing results and remedial actions taken, if any; and
- re-assess regularly the appropriateness of stress tests, including the validity of assumptions used, in the light of changes in the portfolio characteristics or the external environment.

2.1.2 AIs should document the process in the form of a stress-testing policy. The Board of Directors, or a committee formed under the Board with delegated authority, should approve this policy.

2.2 Key elements

2.2.1 This subsection highlights the key elements that a robust and comprehensive stress-testing programme should comprise.

2.2.2 The Board of Directors and senior management should exercise effective oversight of the stress-testing programme. Senior management should be actively involved in the process of designing stress tests and

drawing up plans for remedial action. The Board, or a committee with delegated authority, should approve the stress-testing programme, monitor the results of stress-testing and ensure that suitable actions have been taken to mitigate potential risks. The overall stress-testing process should be managed and coordinated by an independent party (e.g. financial or risk control).

2.2.3 Stress tests should include both quantitative and qualitative criteria. Quantitative criteria should identify plausible stress scenarios, preferably with different levels of severity, to which AIs could be exposed. Qualitative criteria should emphasise that the two major goals of stress-testing are to evaluate the capacity of an AI's capital and earnings to absorb potentially significant losses and to identify the steps that the AI can take to manage its risk (including hedging and asset sales) and conserve capital. This assessment is integral to setting and evaluating an AI's management strategy, which may, for example, involve the AI reviewing the need for limit changes in response to stress-testing results or developing contingency plans in the event that a particular scenario actually happens.

2.2.4 Stress scenarios should, as far as possible, cover on- and off-balance sheet positions of all major portfolios in the trading book and the banking book. They should also reflect specific risk characteristics of an AI's portfolios. All related risk factors should be identified and stressed.

2.2.5 AIs should seek to adopt an integrated approach to stress-testing and produce stress tests on an institution-wide basis. Stress events should cater for all major types of risk, including various components of market, credit, country, liquidity and interest rate risks. Possible linkages across different markets and risks (e.g. the interaction between market risk and counterparty risk) should be identified.

2.2.6 Stress tests should be conducted at suitable intervals having regard to the nature of risks involved. In general, stress tests on market-sensitive portfolios should be run more frequently (say, daily or weekly). These may include trading portfolios in stocks and marketable securities, foreign exchange and interest rate exposures. Other portfolios that are less volatile in nature (e.g. loans) could be

stress-tested at longer intervals (say, monthly or quarterly). AIs should also conduct ad-hoc stress tests on specific areas whenever this is warranted under special circumstances. For example, in the light of rapidly deteriorating economic/political conditions in a country, an AI may need to make a quick assessment of the likely impact on its exposures to that country.

2.2.7 AIs should keep their senior management and relevant business line managers closely informed of the results of stress-testing, drawing their attention to potential risks and vulnerabilities identified and making recommendations for possible courses of remedial action.

2.2.8 AIs should be guided by a clear set of pre-agreed strategies or principles in determining whether remedial actions should be taken in response to stress-testing results. In this regard, triggers for remedial action (e.g. in terms of the size of potential loss or the impact on earnings and capital) may be used. The level of authority for determining remedial actions to be taken should also be clearly designated. Once decided, the remedial actions should be properly documented and implemented.

2.2.9 The types of remedial action to be taken by AIs will vary depending on the circumstances of each case. These may generally include the following:

- restructure, unwind or hedge a position;
- buy credit protection or reduce risk limits;
- tighten underwriting requirements to reduce credit risk;
- build up an additional buffer of capital to cope with the potential impact of stressed conditions;
- amend pricing policies (e.g. on interest spread or margin income) to reflect previously unidentified risks; or
- prepare for the squeeze in liquidity under stressed situations by increasing credit lines and funding sources and managing the liability structure to ensure adequate funding during a crisis.

If it is decided that no immediate corrective action needs to be taken, AIs should systematically monitor and manage the business through more stress-testing and develop contingency plans for the stressed situations.

2.2.10 AIs should ensure that they have adequate information systems to support the stress-testing programme. The systems should be capable of running stress tests on different portfolios and business units and aggregating the stress-testing results for the AI as a whole.

2.2.11 AIs should regularly review and update the methodology and effectiveness of the stress-testing programme to take account of changes in portfolio characteristics and external conditions and to assess whether the underlying assumptions are still valid. Such review should be done at least once a year or more frequently if the portfolio or the environment changes significantly. The review should also cover the following:

- the adequacy of documentation for the stress-testing procedures;
- the integration of stress-testing into daily risk management;
- the approval process for the stress-testing programme, including subsequent authorization for significant changes;
- the scope of exposures captured by the stress-testing programme;
- the integrity of the management information system;
- the accuracy and completeness of position data for stress tests;
- the verification of the consistency, timeliness and reliability of data sources used to run stress tests; and
- the validation of the stress-testing results through back-testing historical scenarios (e.g. the 1997 Asian Crisis) and their impact on the AI's portfolios.

2.2.12 Any proposed changes to the stress-testing methodology and procedures should be approved by senior management.

2.3 Techniques

2.3.1 AIs should employ stress-testing techniques that are most appropriate to the size and complexity of their business activities. They may use a combination of available techniques, including sensitivity tests and scenario analyses.

2.3.2 A sensitivity test estimates the impact on the value of a portfolio of assumed movements in a single risk factor or a small number of closely related risk factors (e.g. a parallel yield curve shift). A scenario analysis measures the change in portfolio value by simulating stress scenarios that affect a number of risk factors (e.g. equity prices, foreign exchange rates and interest rates) together. The stress scenarios can either be based on historical or hypothetical events (see section 3 below).

2.3.3 While a sensitivity test highlights the influence of specific risk factors on a portfolio or business unit, a scenario analysis evaluates the combined effect of the change in all the risk factors encompassed in the stress test. The latter is therefore more often used for generating stress results on an institution-wide basis.

2.3.4 In assessing the relationships between different risk factors, AIs may use complex financial models (e.g. interest rate risk, pricing or statistical models) or less sophisticated means (e.g. judgement based on past experience) that are commensurate with the nature of their portfolios and risks involved. The methods employed should take into account all relevant risk factors and stress scenarios, with results duly incorporated into the risk management process.

2.4 Risk factors

2.4.1 A key step in the stress-testing process is the identification of major risk factors that should be stressed. In drawing up the list of risk factors, AIs should understand the risk characteristics of their portfolios and analyse the risk

factors, as well as the correlation between these factors, that such portfolios are exposed to.

2.4.2 Highlighted below are some common risk factors that are relevant to the banking and trading portfolios of AIs:

- counterparty risk characterised by the increase in default probabilities (e.g. the rise in delinquencies and charge-offs) and worsening of credit spreads. AIs should be aware of the major drivers of repayment ability, such as economic downturns and significant market shocks, that will affect entire classes of counterparties or credits;
- concentration risk in terms of the exposures to individual counterparties, industries, market sectors, countries or regions. AIs should assess the contagion effects and possible linkages between different markets, countries and regions as well as the potential vulnerabilities of emerging markets;
- interest rate risk arising from parallel shifts or twists in the yield curve and the increase in basis risk (i.e. changes in relationships between key market rates);
- market or price risk arising from adverse changes in asset prices (e.g. currencies, equities, commodities, bonds and real estate) and their impact on relevant portfolios and markets;
- liquidity risk as a result of the tightening of credit lines and market liquidity under stressed situations and the impact on funding sources and cash flow assumptions;
- operational risk caused by various factors such as internal or external fraud, system failure and security risks (e.g. in respect of transactional e-banking services);
- product-specific risks such as prepayment risk for mortgages or securitised portfolios;
- abnormal market movements and their impact on contingent credit exposures (e.g. derivatives) and

complex products (e.g. structured products with embedded multiple risks);

- modelling assumptions for value-at-risk or pricing models, including assumptions for correlation, volatility and holding period;
- macro-economic factors (e.g. GDP growth, change in property prices, unemployment rate and inflation or deflation rate) and their impact on other risk factors; and
- various political and economic factors pertaining to industries, regions and emerging markets.

2.4.3 The above list, which is not exhaustive, is for the reference of AIs only. AIs should identify their own risk factors having regard to circumstances specific to their institution. They should ensure that important risk factors or relationships between these factors are not omitted from the analysis. The risk factors identified will form the basis for developing stress events and scenarios (see section 3 below).

2.5 Interpretation of stress-testing results

2.5.1 Despite the benefits of stress-testing mentioned above, AIs should be aware of its limitations when interpreting the results of stress tests.

2.5.2 A stress test estimates the exposure to a specified stress event but does not give the probability of such an event occurring. Moreover, stress-testing is influenced by the judgement and experience of the risk managers designing the stress tests. The effectiveness of stress-testing therefore depends in particular on whether an AI has chosen the "right" scenarios for stress-testing, interpreted the results properly and taken the necessary steps to address the results.

3. Stress scenarios

3.1 General

3.1.1 A scenario analysis measures the combined effect of adverse movements in a number of risk factors. AIs should

determine the appropriate assumptions for stress-testing various risk factors included in a particular scenario and estimate the resultant impact on their financial position (e.g. asset quality, profitability and capital).

3.1.2 In designing stress scenarios, AIs should review lessons from history and tailor the events, or develop hypothetical scenarios, to reflect the risks arising from latest market developments. They should also attempt to incorporate contagion effects to related markets.

3.1.3 The stress scenarios should preferably cover different levels of adversity. As an example, Annex A presents a set of stress scenarios with three levels of increasing adversity, reflecting stressed conditions that are mild, medium and severe. **It should however be noted that the ratios used in the Annex are solely for illustrative purposes.** AIs should formulate the stressed conditions based on their own circumstances.

3.1.4 The 1987 Market Crash, the 1997 Asian Crisis, the 1998 Russian Crisis and the 2001 U.S. Crisis (i.e. the incident of 11 September) are examples of historical events that may be used for developing stress scenarios. These episodes illustrate the relationships between different risk factors and how such relationships could be exacerbated in a crisis. During the Asian Crisis, for instance, various Asian economies suffered from abrupt declines in their asset prices and prolonged economic downturns. Although the overall impact on Hong Kong was in some respects less severe (e.g. the exchange rate of the Hong Kong dollar was not affected), the increase in interest rates and difficult economic conditions[2] weakened borrowers' repayment ability while the substantial correction in property and stock markets reduced collateral coverage on loans. The number of corporate winding-ups and personal bankruptcies also rose. Collectively, these factors had an adverse impact on AIs' asset quality and profitability.

[2] Hong Kong experienced five consecutive quarters of negative GDP growth from January 1998 to March 1999.

3.1.5 AIs may develop hypothetical stress scenarios on the basis of historical crises like those mentioned above. Some of these crises can be used to form "medium" or "severe" stress scenarios, depending on AIs' actual experiences during the crises and the latest market trends (see para. 3.1.8 below).

3.1.6 Severely stressed scenarios can also be viewed as a "harder" version of the historical crises. Under such scenarios, which may typically reflect the characteristics of an extreme economic downturn and severe market shocks, AIs would be able to assess their vulnerability to situations that go beyond previous crises.

3.1.7 A mildly stressed scenario can be one that resembles the economic recession in Hong Kong in the second half of 2001[3]. During this period, the quality of personal lending worsened as a result of the rising unemployment rate and significant increase in personal bankruptcies.

3.1.8 In determining the level of stress to be applied to the stress scenarios, AIs should also have regard to their "baseline" assessment of the normal or expected course of development. The mild, medium and severe scenarios should, in principle, reflect an increasing level of stress compared with the "baseline" situation.

3.2 Types of stress scenarios

3.2.1 This subsection describes various types of stress scenarios that AIs may adopt in their stress-testing exercise[4]. The list, which is not exhaustive, is for the reference of AIs only. AIs should determine the relevance of these scenarios having regard to the nature and risks of their portfolios. Some of the more commonly used scenarios are elaborated in Annex A which helps illustrate how different scenarios and sensitivity tests can be combined or integrated to form a scenario analysis.

---

[3] Hong Kong recorded negative GDP growth of -0.4% and -1.4% in September and December 2001 respectively. The situation is similar to the mild recession scenarios (e.g. two consecutive quarters of zero GDP growth) proposed under the New Basel Capital Accord (see footnote 1).

[4] In drawing up the list, the HKMA has referred to the results of a survey on the stress-testing practices of selected AIs conducted in June 2002.

3.2.2 The following are examples of stress scenarios relating to credit risk :

- Domestic economic downturn – this estimates the impact of adverse changes in selected macro-economic variables (e.g. GDP growth, unemployment rate etc.) on an AI's asset quality, profitability and capital adequacy;
- Economic downturn in major economies affecting Hong Kong (e.g. the U.S., Mainland China and Japan) – this estimates the impact on an AI's corporate borrowers as a result of economic downturn in major economies that have significant commercial/trading links with Hong Kong. As an example, the impact could be measured in terms of a drop in borrowers' business revenues or an increase in the default risk of their trading counterparties. The scenario could be extended to include other shocks in those economies (e.g. stock market crisis);
- Decline in the real estate market – this estimates the impact of decline in property prices on collateral coverage, default risk and provisioning needs for loans secured by properties. In the case of a residential mortgage portfolio, AIs can assess the impact of resultant increase in loans in negative equity and specific provisions (based on assumptions of the probability of default for such loans) (see Annex A for further illustration);
- Increases in classified loans and provisioning levels – this assesses the resilience of an AI's corporate portfolio in terms of the impact of such increases on profitability and capital adequacy. In designing the scenario, AIs may apply different percentages of increase in classified loans and provisioning levels to its corporate loans (see Annex A for further illustration). Alternatively, it may conduct a loan migration test, i.e. assuming that a certain percentage of loans in each of the first four categories of the HKMA's five-grade loan

classification system[5] is downgraded to the next category;

- Failure of major counterparties – this estimates the impact of failure of an AI's major counterparties, including corporate and interbank counterparties, on its profitability and capital adequacy. The test can be extended to cover aggregate exposures to major industries, market sectors, countries and regions (e.g. by assuming that a significant number of defaults occur within such aggregate exposures);
- Deterioration in the quality of consumer lending – this estimates the impact of rising unemployment rate and personal bankruptcies on retail portfolios such as credit card receivables and personal loans. An appropriate scenario would be to assume a further rise in the level of charge-offs for such lending taking into account the projected increase in the unemployment rate and personal bankruptcies (see Annex A for further illustration); and
- Decline in the value of taxi licences / gross operating income of taxi drivers – this estimates the impact on an AI's taxi loan portfolio in terms of collateral coverage, default risk and provisioning needs.

3.2.3 The following are examples of stress scenarios relating to interest rate risk :

- Repricing risk – this assesses the effects on an AI's profitability due to timing differences in interest rate changes and cash flows in respect of fixed and floating rate assets, liabilities and off-balance sheet instruments;
- Basis risk – this assesses the effects on an AI's profitability due to unfavourable differential changes in key market rates (e.g. HIBOR and the prime rate) (see Annex A for further illustration);
- Yield curve risk – this assesses the effects on an AI's profitability due to parallel yield curve shifts (up and

[5] The five loan classification categories comprise Pass, Special Mention, Substandard, Doubtful and Loss.

down) and non-parallel yield curve shifts (i.e. steepening or flattening of the yield curve); and

- Option risk – this assesses the effects of changes in the value of both stand-alone option instruments (e.g. bond options) and embedded options (e.g. bonds with call or put provisions and loans which give borrowers the right to prepay outstandings) due to adverse interest rate movements.

AIs may conduct the above scenarios using gap analyses or simulation techniques (see IR-1 "Interest Rate Risk Management" for more details on these techniques).

3.2.4 The following are examples of stress scenarios relating to other risks :

- Decline in net interest income – this estimates the impact on an AI's net interest income due to negative loan growth or squeezes in pricing caused by competition for new business;
- Adverse changes in exchange rates between major currencies – this estimates the impact on an AI's net open positions in major currencies. AIs should also assess the impact of such changes on their major customers with substantial foreign exchange exposures. Such exposures could arise from the customers' foreign currency assets, liabilities or income streams;
- Decline in market value of financial instruments – this estimates the impact of adverse changes in market prices (e.g. exchange rates or interest rates) and liquidity conditions on the market values of financial instruments (e.g. corporate bonds and derivatives);
- Widening of credit spreads – this captures the risk of increases in credit spreads of bonds in a particular market (e.g. an industry sector or a region) due to problems in that market;
- Downgrade in the credit ratings of debt issuers (e.g. two notches down) – this estimates the impact on an AI's holdings of debt securities in terms of value and liquidity;

- Decline in stock prices/indices – this estimates the effect on an AI's share margin lending or holdings of stocks;
- Liquidity crisis – this analyses the adequacy of an AI's short-term liquidity to meet crisis situations (e.g. significant deposit outflows, tightening of credit lines etc.). In assessing the impact on the AI's funding and cash flow projections, it may adopt behavioural assumptions for borrowers and depositors. For example, the scenarios can link the level of cash flows with different assumed patterns of loan prepayments and deposit withdrawals; and
- Business disruption or system failures – this assesses the effects of such disruptions or failures (e.g. hardware and software failures, telecommunication problems and utility outages).

3.3 An illustration

3.3.1 This subsection provides a walk-through illustration of some typical stress scenarios associated with credit and interest rate risks, which are still the main sources of risk for AIs in Hong Kong. Worksheet A describes how an AI can use the scenario of a domestic economic downturn to assess the impact on its financial position while Worksheet B sets out two hypothetical stress scenarios to assess the basis risk for Hong Kong dollar interest rates[6]. AIs may use the sample worksheets as a reference for developing their stress tests.

3.3.2 **It should be emphasised that the scenarios used, including the parameters or estimations made, in the worksheets are solely for illustrative purposes.** AIs should develop their own stress scenarios based on the nature of their portfolios and the risks involved.

———————

[6] For the avoidance of doubt, the stress scenarios illustrated under Annex A and the two worksheets have different assumptions and parameters and are therefore not directly comparable.

Annex A: Examples of stress scenarios[1]

		Stress scenario[2]		
Scenario components[3]	**Stressed items**	**Mild**	**Medium**	**Severe**
Retail exposures	Residential mortgage loans			
	• Loans in negative equity	• Property prices further decline by 10%	• Property prices further decline by 20%	• Property prices further decline by 30%
	• Probability of default on loans in negative equity	• 10%	• 15%	• 20%
	• Specific provisions	• 100% of unsecured portion of defaulted loans	• 100% of unsecured portion of defaulted loans	• 100% of unsecured portion of defaulted loans
	Credit card receivables			
	• Specific provisions / direct write-offs	• Increase by 50%	• Increase by 100%	• Increase by 150%
	Other personal loans			
	• Specific provisions / direct write-offs	• Increase by 50%	• Increase by 100%	• Increase by 150%
Corporate exposures	• Classified loans	• Increase by 50%	• Increase by 100%	• Increase by 120%
	• Specific provisions[4]	• 40% of gross amount of classified loans	• 50% of gross amount of classified loans	• 60% of gross amount of classified loans
Interest rate risk exposures	• Prime rate	• Decrease by 100 basis points	• Unchanged	• Unchanged
	• Savings deposit rate	• Unchanged	• Increase by 200 basis points	• Increase by 400 basis points
	• HIBOR	• Unchanged	• Increase by 200 basis points	• Increase by 400 basis points
	• Time deposit rate	• Unchanged	• Increase by 200 basis points	• Increase by 400 basis points
Operating profit before provision[5]	• Non interest income	• Decrease by 20%	• Decrease by 30%	• Decrease by 40%
	• Net interest income	• Decrease by 10%	• Decrease by 20%	• Decrease by 30%

[1] This annex illustrates how a few sensitivity tests can be put together to form a scenario analysis. **The ratios used in this annex are for illustration only.** AIs should determine their own assumptions when conducting these stress tests.

[2] The mild and severe scenarios represent three levels of increasing stress for a stress period of one year. The stress scenarios are used to assess the impact of the stressed items on an AI's overall profitability and capital adequacy (due to reduction in pre-provision operating profit and increase in bad debt charges).

[3] Where applicable, the portfolios covered under the stress scenarios should include off-balance sheet exposures.

[4] For the sake of simplicity, the collateral value of classified loans is not taken into account.

[5] In projecting the pre-provision operating profit for the stress period, AIs may refer to the profit for the previous period with a discount to reflect more difficult operating conditions.

Worksheet A: Illustration of stress-testing for credit risk

A1. Introduction

A1.1 This worksheet sets out some typical stress-testing methods for credit risk. **The figures used in the worksheet are solely for illustrative purposes**. AIs should compute the figures based on their own stress scenarios.

A1.2 The scenario chosen in the example is that of an economic downturn, which is a typical stress scenario that AIs can use for assessing the impact on their asset quality, provisioning, profitability and capital adequacy should economic conditions deteriorate. A number of relevant macro-economic indicators, i.e. unemployment rate, real GDP growth, real interest rate, number of bankruptcy petitions and property price and equity indices, are used for developing different scenarios.

A1.3 Section A2 illustrates the scenarios of adverse changes in the macro-economic indicators over the next 12 months under three states of the domestic economy, namely the mild, medium and severe scenarios. Based on each scenario, AIs should estimate the projected positions at the end of the next 6 and 12 months under section A3. These positions, in aggregate or by major sector, relate to the following:

- outstanding loans and advances;
- asset quality measured by the level of classified loans and delinquency ratio;
- collateral value for classified loans; and
- level of general and specific provisions.

A1.4 In determining the projected loan balances, AIs should, among other things, consider the fact that loan growth may slow down as investments and consumption contract during a downturn. This may also put pressure on AIs' revenues and interest spread as they compete for limited business.

A1.5 In assessing the projected level of classified loans and specific provisions (or bad debt charges), AIs should determine the relationship between specific economic variables and the credit quality of their portfolios. For example, an AI may estimate that the deterioration in various macro-economic indicators, such as a rise in unemployment rate and an increase in real interest rate, will drive up the delinquency ratio and the level of charge-offs for personal loans under the stress scenarios. Likewise, the AI may estimate that a decline in property prices, together with other adverse economic conditions, will lead to an increase in the delinquency ratio for residential mortgage lending, a reduction in collateral coverage and a rise in bad debt charges for such loans. For a corporate portfolio, the AI may re-assess the probability of default and loss given default for individual loans under the stress scenarios and roll the results up to the portfolio level.

A1.6 AIs may determine the magnitude of the above projections based on their professional judgement with reference to historical relationships and trends. They may also make use of statistical models for estimating the effects on their portfolios.

A1.7 Sections A4 and A5 summarise the resultant impact on the AI's operating profits and capital adequacy ratio (if it is locally incorporated) under the three different scenarios, taking into account changes in asset quality and provisions projected in section A3 and bad debt charges for individual loan types in section A4.

A1.8 Due to the different activities undertaken by AIs, they may come up with macro-economic indicators other than those specified in section A2 that are relevant to their portfolios. AIs may also need to develop other scenarios relating to specific industries or countries to which they have large exposures.

A2. Scenarios (Note 1)

Type of macro-economic indicators	Projected position for the next 12 months			
	Baseline (Note 2)	Mild (Note 3)	Medium (Note 4)	Severe (Note 5)
Unemployment rate (at the end of the next 12 months)	8.0%	8.5%	9.5%	11.0%
Annual real GDP growth (year-on-year change)	1.0%	-1.0%	-5.0%	-9.0%
Real interest rate (at the end of the next 12 months) (Note 6)	-0.5%	2.0%	4.0%	6.0%
Residential and commercial property prices (year-on-year change)	-3.0%	-10.0%	-20.0%	-30.0%
Hang Seng Index (year-on-year change)	-5.0%	-10.0%	-20.0%	-40.0%
Bankruptcy petitions (year-on-year change)				
of which:				
Personal bankruptcy	+30%	+100%	+150%	+200%
Corporate winding-up	+5%	+20%	+30%	+40%
Other indicators specified by the AI				

Notes:

(1) **The figures listed in the above table are for illustration only and should not be construed as forecasts by the HKMA. In conducting this stress test, AIs should determine their own assumptions.**

(2) The baseline scenario represents the normal or expected course of economic development. The other three stress scenarios are benchmarked against the baseline scenario.
(3) The mild scenario represents slightly deteriorated economic conditions.
(4) The medium scenario represents a state of prolonged economic recession.
(5) The severe scenario is designed to represent an extreme economic downturn.
(6) Real interest rate denotes the difference between nominal interest rate measured by 3-month HIBOR and the inflation rate measured by CPI(A).

A3. Information worksheet (asset quality) (Notes 1 and 2)

(all figures in HK$Mn unless otherwise stated)

		Position as at end of last quarter (as reported in the banking returns)	Projected position as at end of next 6 months (Note 3)			Projected position as at end of next 12 months (Note 3)		
			Mild	Medium	Severe	Mild	Medium	Severe
Outstanding positions before provisions								
Total loans and advances	[Part I : Item L (Col. 4)]	35,799	35,727	35,620	35,441	35,656	35,442	35,087
Classified loans of which:								
Substandard	[Part II: Item A.1. (Col. 3)]	503	543	553	755	587	609	905
Doubtful	[Part II: Item A.1. (Col. 4)]	437	476	524	699	519	577	909
Loss	[Part II: Item A.1. (Col. 5)]	260	286	338	442	315	389	663
Asset quality of selected sectors								
1. Residential mortgage lending								
Outstanding amount	[Part I: Item H5.b. (Col 4)]	14,543	14,834	14,470	14,398	15,131	14,398	14,254
Classified loan ratio (Note 4)		1.6%	1.6%	1.9%	2.3%	1.7%	2.2%	3.5%
Delinquency ratio (Note 5)		1.3%	1.4%	1.6%	2.0%	1.4%	1.9%	2.9%
Specific provisions	[Part I: Item H5.b. (Col 5)]	25	28	33	41	30	40	62
2. Property investment - Residential and Commercial								
Outstanding amount	[Part I: Item C.1.e. & Item C.2.e (Col 4)]	4,636	4,729	4,543	4,451	4,823	4,452	4,273
Classified loan ratio		6.0%	6.3%	7.2%	9.0%	6.6%	8.6%	13.5%
Delinquency ratio		5.0%	5.3%	6.0%	7.5%	5.5%	7.2%	11.3%
Specific provisions	[Part I: Item C.1.e. & Item C.2.e (Col 5)]	57	63	75	94	69	90	141
3. Trade financing								
Outstanding amount	[Part I: Item J (Col 4)]	2,437	2,486	2,425	2,413	2,535	2,413	2,389
Classified loan ratio		3.0%	3.2%	3.6%	4.5%	3.3%	4.3%	6.8%
Delinquency ratio		2.5%	2.6%	3.0%	3.8%	2.8%	3.6%	5.6%
Specific provisions	[Part I: Item J (Col 5)]	19	21	25	31	23	30	47
4. Loans to professional and private individuals for other private purposes								
Outstanding amount	[Part I: Item H5.e. (Col 4)]	2,566	2,617	2,553	2,540	2,670	2,540	2,515
Classified loan ratio		7.2%	7.6%	8.6%	10.8%	7.9%	10.4%	16.2%
Delinquency ratio		6.0%	6.3%	7.2%	9.0%	6.6%	8.6%	13.5%
Specific provisions	[Part I: Item H5.e. (Col 5)]	62	68	82	102	75	98	153
5. Credit card advances								
Outstanding amount	[Part I: Item H5.c. (Col 4)]	2,654	2,707	2,641	2,627	2,761	2,628	2,601
Classified loan ratio		1.6%	1.6%	1.9%	2.3%	1.7%	2.2%	3.5%
Delinquency ratio		1.3%	1.4%	1.6%	2.0%	1.4%	1.9%	2.9%
Specific provisions	[Part I: Item H5.c. (Col 5)]	31	34	41	51	38	49	77
Loans to other significant sectors not included above (Note 6)								
Outstanding amount								
Classified loan ratio								
Delinquency ratio								
Specific provisions								
Collateral value for classified loans								
Substandard	[Part II: Item G.1. (Col 3)]	336	372	303	328	402	333	393
Doubtful	[Part II: Item G.1. (Col 4)]	279	312	275	290	340	302	377
Loss	[Part II: Item G.1. (Col 5)]	137	154	146	151	170	168	227
Loan provisions								
General provisions for all loans	[Part II: Item A.4. (Col 6)]	329	375	463	532	481	567	702
Specific provisions for classified loans								
Substandard	[Part II: Item A.5. (Col 3)]	70	76	85	116	82	110	164
Doubtful	[Part II: Item A.5. (Col 4)]	160	174	211	282	190	275	433
Loss	[Part II: Item A.5. (Col 5)]	143	157	204	267	173	278	474

Notes:

(1) This worksheet should be prepared based on combined positions for local AIs and Hong Kong office positions for other AIs.
(2) Items in brackets are references to the "Return of Quarterly Analysis of Loans and Advances and Provisions - MA(BS)2A". Any references to Part I of the Return which collects positions of Hong Kong offices are solely for defining the business sectors. The combined positions should still be reported.
(3) The positions referred to here should be projected by AIs using the mild, medium and severe scenarios in section A2 above.
(4) Classified loan ratio is defined as the ratio of classified loans (including substandard, doubtful and loss) to total outstanding loans.
(5) Delinquency ratio is defined as the ratio of loans that have been overdue for more than three months to total outstanding loans.
(6) Significant sectors are defined as those which represent 5% or more of total loans and advances.

A4. Information worksheet (profitability) (Notes 1 and 2)

(all figures in HK$Mn unless otherwise stated)

		Position for last 6 months (as reported in the banking returns)	Projected position for next 6 months			Projected position for next 12 months		
			Mild	Medium	Severe	Mild	Medium	Severe
Profitability (Note 3)								
Total income	[Part I Item 7]	1,219	1,195	1,000	912	2,365	1,950	1,778
of which:								
Net interest income	[Part I Item 1]	767	752	729	690	1,488	1,421	1,346
Other income	[Part I Item 7]-[Part I Item 1]	452	443	271	221	877	529	432
Net charge/(credit) for debt provisions (Note 4)	[Part I Item 10]	298	477	656	894	1,049	1,508	2,101
of which:								
Increase in general provisions		24	46	134	203	152	238	373
Increase in specific provisions/direct write-offs (Note 5), of which:		274	431	522	691	897	1,270	1,728
1. Residential mortgage lending		15	30	58	115	60	131	236
2. Property investment - Residential and Commercial		14	19	45	67	43	92	135
3. Trade financing		5	5	12	19	13	28	41
4. Loans to professional and private individuals for other private purposes		21	105	123	152	252	278	379
5. Credit card advances		186	230	238	289	437	553	679
6. Off-balance sheet exposures		21	25	28	29	55	113	155
7. Other exposures		14	17	18	19	37	75	103
Total expenses (include debt provisions)	[Part I Item 12]	926	1,105	1,284	1,522	2,305	2,764	3,357
Operating profit/(loss)	[Part I Item 13]	293	90	-284	-610	60	-814	-1,579

A5. Information worksheet (capital adequacy) (Notes 1, 2 and 6)

		Position as at end of last quarter (as reported in the banking returns)	Projected position as at end of next 6 months			Projected position as at end of next 12 months		
			Mild	Medium	Severe	Mild	Medium	Severe
Capital adequacy (Note 7)								
Total capital base after deductions	[Part IV Item 1]	6,539	6,579	6,255	5,929	6,566	5,725	4,960
Total net risk-weighted exposures	[Part IV Item 2.5]	36,921	37,199	36,104	35,689	37,391	35,101	34,168
Capital adequacy ratio	[Part IV Item 3]	17.71%	17.69%	17.33%	16.61%	17.56%	16.31%	14.52%

Notes:

(1) The worksheet should be prepared based on combined positions for local AIs and Hong Kong office positions for other AIs.
(2) The positions referred to here should:
  (a) be projected by AIs using the mild, medium and severe scenarios in section A2 above; and
  (b) take into account the estimated impact arising from changes in asset quality and provisions as projected in section A3 and increase in bad debt charges in section A4.
(3) Items in brackets are references to the "Return of Current Year's Profit & Loss Account - MA(BS)1C".
(4) It is assumed that there are no debt recoveries during the stress periods.
(5) Refer to the amount of debts written off where no previous provisions had been established.
(6) Section A5 is to be reported by locally incorporated AIs.
(7) Items in brackets are references to the "Return of Capital Adequacy Ratio - MA(BS)3".

Worksheet B: Illustration of stress-testing for Hong Kong dollar interest rate risk

B1. Introduction

B1.1 A change in the relationships between key market rates (i.e. basis risk) is an important source of interest rate risk for AIs in Hong Kong. This worksheet sets out two hypothetical stress scenarios to assess Hong Kong dollar basis risk:

- a drop of 200 basis points in the prime rate but no change in term and savings deposit rates and HIBOR; and
- an increase of 200 basis points in term and savings deposit rates and HIBOR but no change in the prime rate.

The figures quoted in this worksheet are solely for illustrative purposes. AIs should compute the figures based on their own stress scenarios.

B1.2 The two scenarios mentioned above will have the effect of squeezing AIs' interest spread and reducing their total earnings. The magnitude of the squeeze can be changed to reflect AIs' perception of interest rate trends. AIs could also use other scenarios to measure basis risk for their own purposes. There are other sources of interest rate risk, including repricing risk, yield curve risk and option risk, that could affect the financial position of AIs. They should therefore design stress tests that are commensurate with their risk profile.

B1.3 AIs can review the stress-testing results generated from credit risk and interest rate risk on a combined basis to assess the overall impact on earnings and capital adequacy.

B2. Information Worksheet

Stress scenarios (Note 1)	Projected reduction in earnings	
	for next 6 months **(HK$ Mn)**	for next 12 months **(HK$ Mn)**
Scenario 1 Prime rate decreases by 200 basis points while savings deposit rate, HIBOR and time deposit rates remain unchanged (Note 2)	-282	-589
Scenario 2 Prime rate remains unchanged while savings deposit rate, HIBOR and time deposit rates increase by 200 basis points (Note 2)	-338	-762
Other scenarios specified by the AI (Note 3)		

Notes:

(1) For this part of the stress test, AIs should assess the impact on earnings solely on the basis of the hypothetical scenarios. Where appropriate, AIs can incorporate the estimated changes in their interest bearing assets and liabilities under the hypothetical scenarios. For instance, an AI may expect an increase in prime-based loans if the prime rate drops by 200 basis points as assumed in Scenario 1.

(2) The stressed situation is assumed to last until the end of the assessment period.

(3) AIs can determine other stress scenarios which reflect the risk characteristics of their interest rate positions. For example, AIs which are net interbank borrowers may need to devise a scenario of a surge in 3-month HIBOR.