

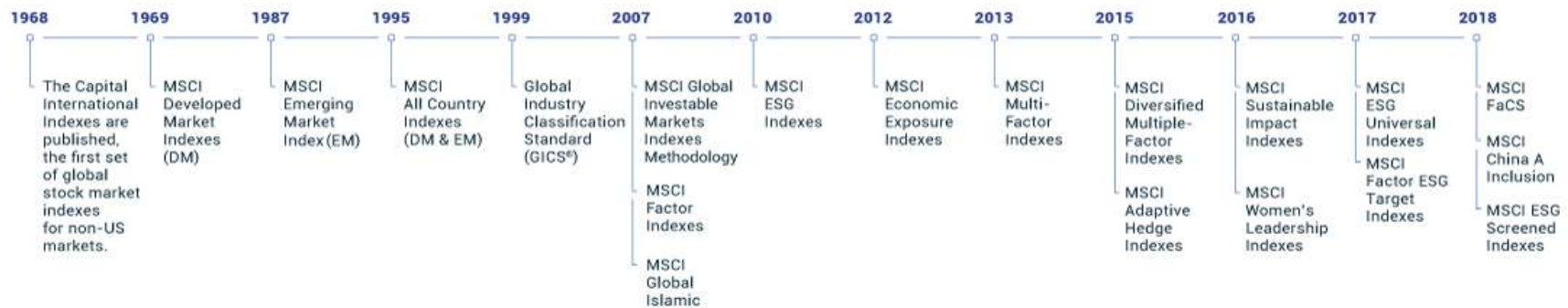
# ■ Kutatók Délutánja

**TTK Pénzügyben**

MSCI, Sept 2019



# ► MSCI: A Global Index Powerhouse



MSCI is a leading provider of investment decision support tools to **over 7,000 clients worldwide**, ranging from large pension plans to boutique hedge funds

MSCI continues to leverage its **deep understanding of the world's financial markets** to turn data-driven insights into products and services designed to **help our clients make more informed investment decisions**

MSCI is dedicated to supporting the increasingly complex needs of the investment community with **groundbreaking new products**, high quality data, superior distribution and dedicated client support

MSCI is proud of its reputation as a **pioneer in the index and risk management space**



# MSCI AT A GLANCE



**7,000<sup>1</sup>**

Clients  
in 90 Countries

Global footprint  
Across investment  
and trading spectrum  
Engrained in  
the world's most  
sophisticated investors



**Innovative**  
Products and  
Services

Analytics  
ESG  
Factors  
Indexes  
Real Assets



**3,200**

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200+ researchers  
1,500 technologists &  
data scientists  
700 coverage &  
marketing professionals



**Strong**  
Performance  
and Inclusive Culture

Global, multi-cultural  
workforce  
Driving innovation for  
industry leading  
solutions

<sup>1</sup> Number of clients based on the shipping address of the ultimate customer utilizing the product which counts affiliates, user locations, or business units within a single organization as separate clients.  
As of 5/9/2019

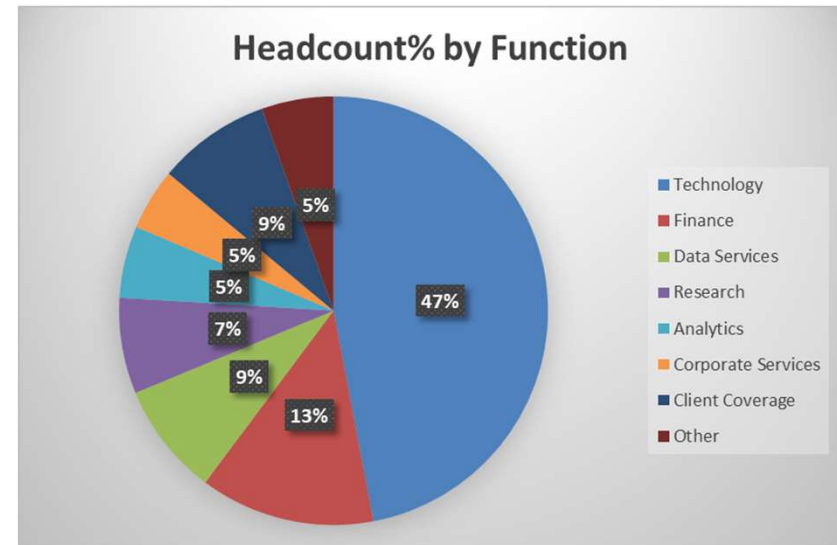
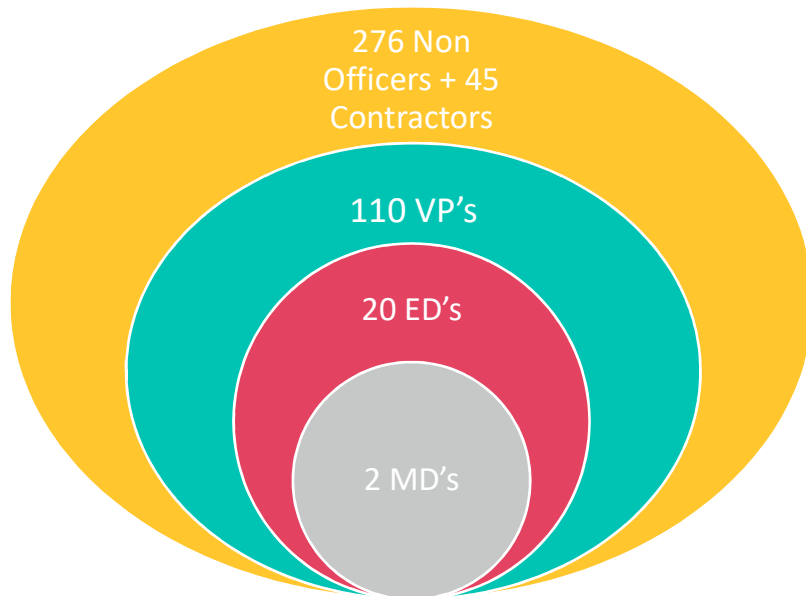
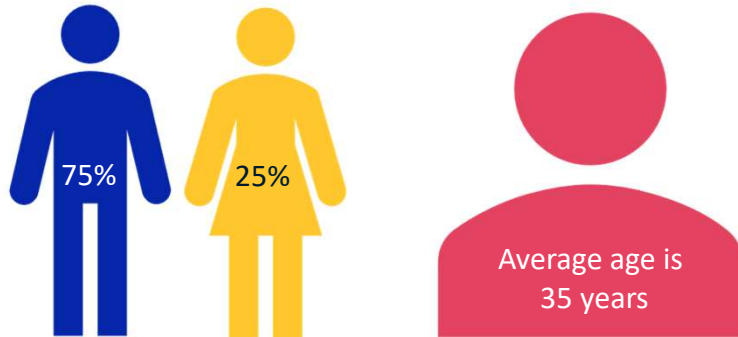






## ► Budapest overview – as of end Q2 2019

**2nd largest office** at MSCI with **453 colleagues**  
(408 employees + 45 contractors/vendors)



Office is growing, **additional office space** will be added in Q1 2020

Active **recruiting** for the following major areas:

Application Development and Testing, IT Security Engineering, Infrastructure Engineering, Data Services, Finance



## ► Budapest – Major functions



- MSCI Beon will deliver MSCI's high-quality content, risk analytics, and portfolio management tools in one place; integrates with your data and analytics, plus data and analytics from third-party sources.

- Software development, Analytical/Functional testing and Operation of MSCI's Analytics products
- Project management and Operation of our Data Services function
- Information Security – HQ for Engineering and Operations
- Infrastructure Engineering
- Research, Quantitative modeling
- 70% of Corporate Finance is located in Budapest
- Business facing teams of Sales Support, Solution Management, Client Service, Marketing



# ▶ Bevezetés a pénzügyi matematikába

Rövid bevezetés a matematika használatába a pénzügyi világban

Milán Vancsa

2019.09.27



# Agenda

- **Néhány példa pénzügyi termékekre:**
  - Kötvény, Részvény, Opció, ....
- **Kockázatok**
  - Kockázatok szerepe
  - Kockázat identifikálása
- **Kockázat modellezés**
- **Matematika eszköztár**
  - Leggyakoribb eszközök
  - Egyéb



# ▶ Egyszerű pénzügyi termékek

Kötvények, részvények, Opciók



# Példák

- **Kötvények:**
- **Részvények:**
- **Opciók:**



# Példák

- **Kötvények:**
  - Hitelviszonyt testesít meg. A kibocsátó vállalja, hogy egy adott pénzösszeget és annak meghatározott kamatát fizeti előre meghatározott
- **Résztvények:**
  - Tulajdonjogok megtestesítő értékpapír
- **Opciók:**
  - Előre meghatározott időpontokban biztosít vételi (vagy eladási lehetőséget) egy mögöttes termékre.





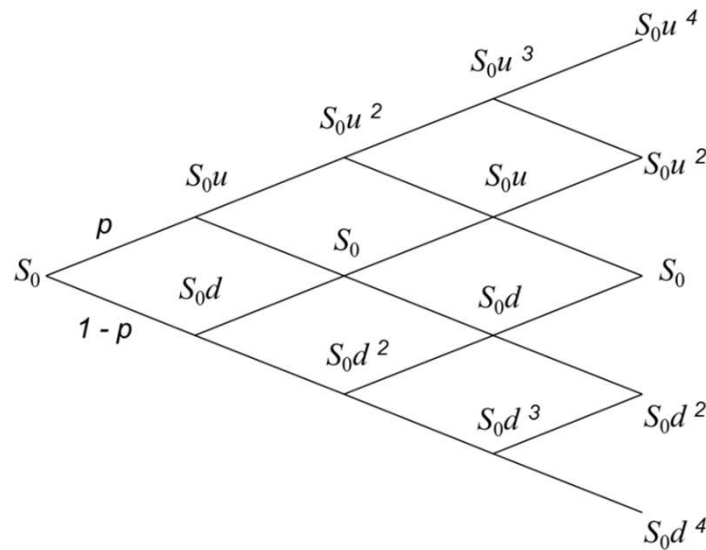
# Kockázatok felismerése és modellezése

Vegyük az előző példát



# Vizsgáljuk meg a részvényre szóló opció alakulását

- Legyen a példánk egy részvényre szóló vételi opció:
  - Az előre meghatározott ár legyen:  $K$
  - Lejáratkor a kifizetés:  $\max(S(T) - K, 0)$
- Feltételezés az alaptermék áralakulására:
- Ekkor:  $C = E(\max(S(T) - K, 0))$
- Általánosabban is megfogalmazható:
  - $\text{Price} = E(f(S(T)))$





# Vizsgáljuk meg a részvényre szóló opció alakulását

## Apple's shares in 2018

Share price in US Dollars



Source: Bloomberg. Last update: 21/11/2018, 8:00am GMT

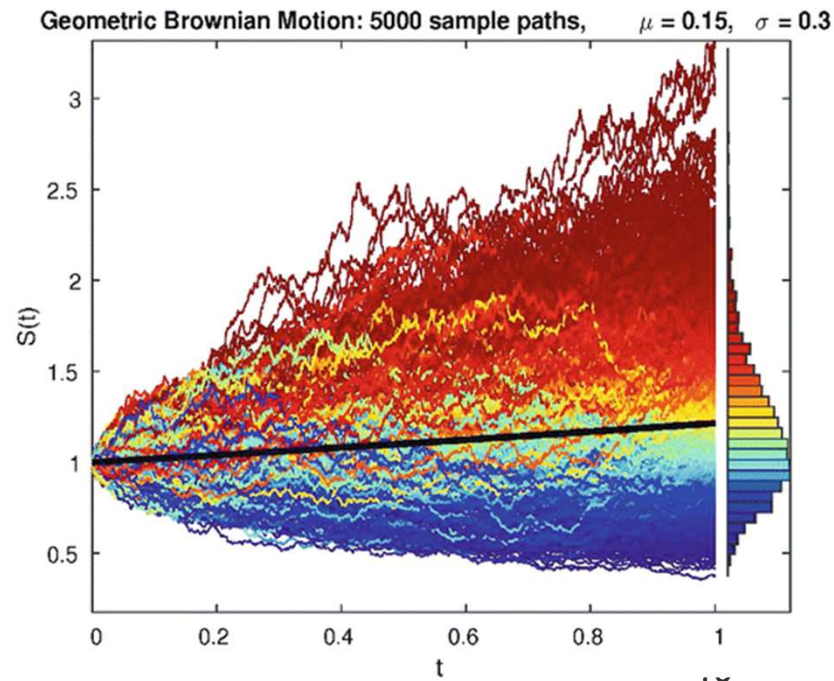
BBC

Forrás: BBC



# Vizsgáljuk meg a részvényre szóló opció alakulását

- Folytonos idő:
  - Sztochasztikus folyamatok
- Mit szeretnénk elérni:
  - Hasonló folyamatunk legyen, mint a részvényár a piacon
  - Analitikusan követhető legyen
  - Példa: Geometria Brown mozgás
$$dS(t) = \mu S(t)dt + \sigma S(t)dW(t)$$
- Innen a feladat ugyanaz, mint korábban:
$$\text{Price} = E(f(S(T)))$$





# ▶ Matematikai Eszköztár

## Pénzügyi modellezés



## ► Hozzávalók

- **Amit már eddig is láttunk:**
  - Valószínűségszámítás
  - Sztochasztikus folyamatok
  - Sztochasztikus analízis
- **Egyéb:**
  - Optimalizálás:
    - Példa: Van egy portfólióm, amitől elvárok valamekkora hozamot, de bizonyos korlátokat betartva
  - Szimuláció:
    - Analitikus megoldások hiányban
  - Statisztika/ökonometria:
    - PI: Előrejelzési módszerek
  - Gépi Tanulás:
    - Modell kalibrálás
    - Lásd következő előadás

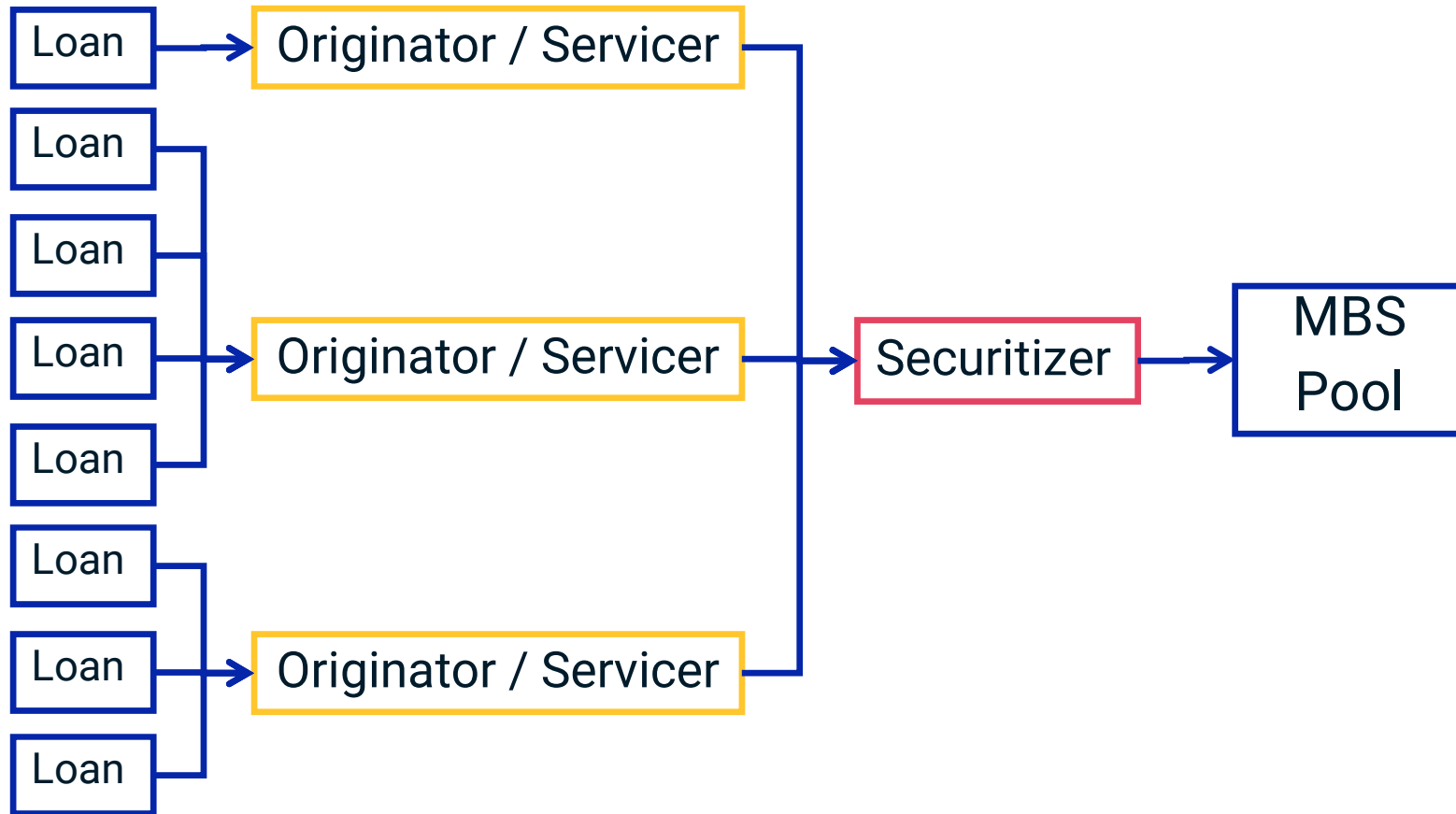




# Köszönöm a figyelmet!



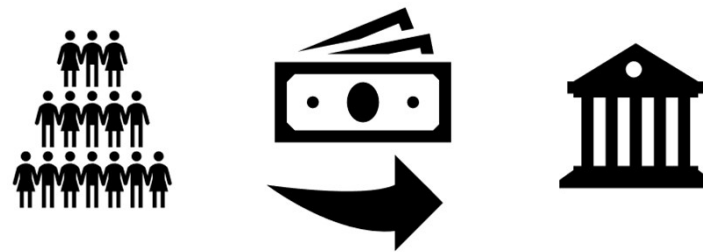
## ► Mortgage-Backed Securities (MBS)





## Main Risk: Prepayment

### Unscheduled Principal Payment



May come from:

- Turnover
- Refinancing
  - Rate, term
  - Cash out
- Default
- Curtailment

Might be affected by:

- General hardship
- Lock out
- Underwriting standards
- Psychology of the individual
- Media effect
- Malicious intent



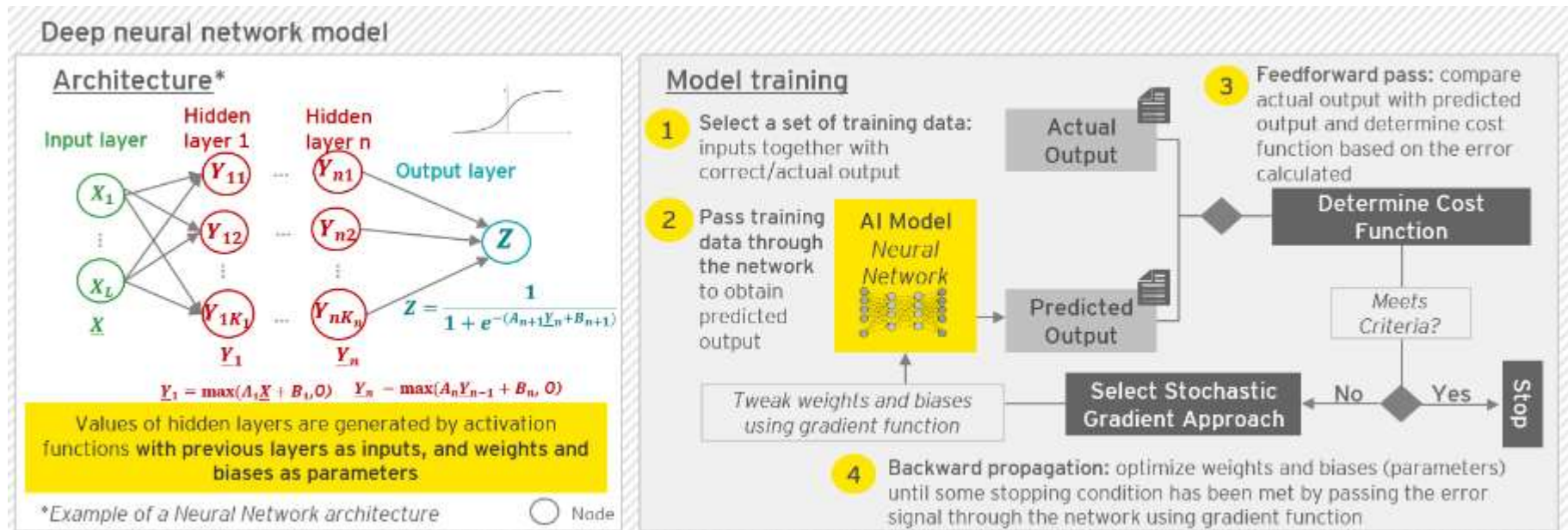
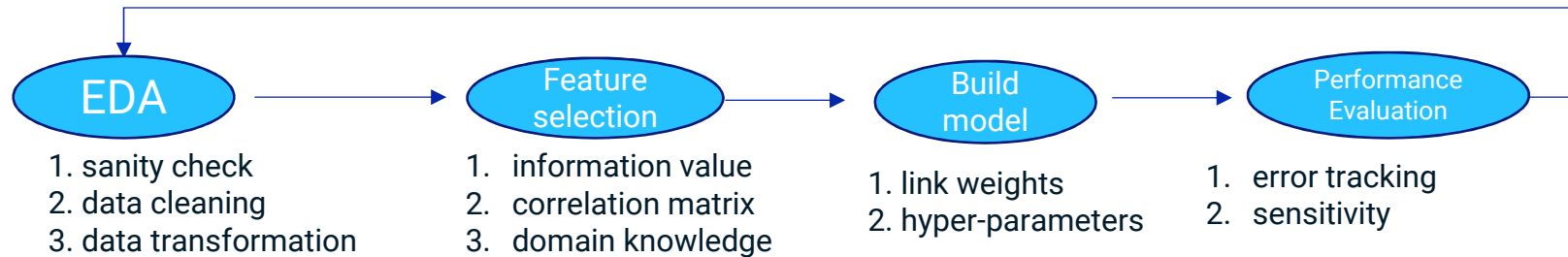
## ► Modeling Objective

Forecast monthly prepayment rate for Agency RMBS pools

- Measure: monthly SMM - Single Monthly Mortality Rate
- Historical periods: 2003-2015 (train, validate), 2016-2018 (test)
- Raw data:
  - Mortgage characteristics (30 raw attributes from eMBS ~25GB)
  - Macroeconomic and Market conditions:
    - Home Price Index (State level)
    - Mortgage rate
    - Unemployment rate



# Modeling Process





# ■ Acknowledgements

Joint effort of MSCI and Ernst & Young

## **MSCI, Securitized Products Research**

- David Zhang, Managing Director
- Joy Zhang, Executive Director

## **Ernst & Young**

- Jan Zhao, Principal, Advanced Analytics
- Fei Teng, Senior Quantitative Analysts, Quantitative Advisory Services
- Siyu Lin, Senior Quantitative Analysts, Quantitative Advisory Services
- Henry Li, Executive Director, Quantitative Advisory Services

## **Publications:**

- 2018, D., Zhang, et. al., [Agency MBS Prepayment Model Using Neural Networks](#), Journal of Structured Finance
- Blogpost on msci.com – coming soon



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## Contact us

AMERICAS		EUROPE, MIDDLE EAST & AFRICA		ASIA PACIFIC	
Americas	+1 888 588 4567 *	Cape Town	+ 27 21 673 0100	China North	10800 852 1032 *
Atlanta	+ 1 404 551 3212	Frankfurt	+ 49 69 133 859 00	China South	10800 152 1032 *
Boston	+ 1 617 532 0920	Geneva	+ 41 22 817 9777	Hong Kong	+ 852 2844 9333
Chicago	+ 1 312 675 0545	London	+ 44 20 7618 2222	Mumbai	+ 91 22 6784 9160
Monterrey	+ 52 81 1253 4020	Milan	+ 39 02 5849 0415	Seoul	00798 8521 3392 *
New York	+ 1 212 804 3901	Paris	0800 91 59 17 *	Singapore	800 852 3749 *
San Francisco	+ 1 415 836 8800			Sydney	+ 61 2 9033 9333
São Paulo	+ 55 11 3706 1360			Taipei	008 0112 7513 *
Toronto	+ 1 416 628 1007			Thailand	0018 0015 6207 7181 *
				Tokyo	+81 3 5290 1555

- = toll free

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