Cost vs. Risk Tradeoffs in IaaS Clouds

- **On-Demand**: Cheapest, higher rejection risk, non-revocable demand risk.
- **Reserved**: More expensive, higher demand risk, non-revocable risk.
- **Spot**: Expensive, high rejection risk, revocable risk.

Cost (per hour) vs. Risk:
- **Cheap** → **Expensive**
- **Risk**
  - Rejection Risk, Non-Revocable
  - Demand Risk, Non-Revocable
  - Rejection Risk, Revocable
Reserved Instance (RI) Risks

- RI’s only cheaper than on-demand if highly utilized

- Accurately forecasting demand over long periods is challenging
  - Unforeseen events like COVID-19 can substantially change demand

- Reserved VMs expose users to substantial demand risk
  - Due to the gap between forecasted and actual demand

- To mitigate demand risk...
  - ...Amazon operates the Reserved Instance Marketplace (RIM)
Reserved Instance Marketplace (RIM)

- RIM allows users to sell VM reservations at a price they set
  - After listing reserved VMs, EC2 posts them on the RIM

- Enables purchasing variable and shorter-term VM reservations
  - AWS only offers 1-year and 3-year reservations on the market
Comparing RIM with the Spot Market

• RIM is a competitive market with multiple buyers and sellers
  - In contrast, EC2’s spot market has only a single seller (Amazon)
  - Spot price not set based on instantaneous supply/demand

• RIM is akin to the housing market with many unique listings
  - Listing value defined by a large set of attributes
  - E.g., VM type, number of instances listed, term duration, supply/demand, etc.

• Spot market is akin to the stock market
  - Uniform pricing of many identical assets (VMs) across regions and AZs
RIM Pricing

• Clearly, RIM’s usefulness is a function of its prices
  - But, EC2 does not automatically archive RIM price data

• We started monitoring and archiving RIM prices in 2018/9
  - Query RIM using EC2’s python Boto3 API every 30 minutes
  - Collect data for all VM types in 69 AZs across 22 regions

• Publicly released data at UMass Trace Repository
  - [http://traces.cs.umass.edu/index.php/Main/Cloud](http://traces.cs.umass.edu/index.php/Main/Cloud)
A First Look at RIM Data

• Analyze RIM data from 2018/9 to 2020/5
  - Reveal important market characteristics
  - Identify potential reserved VM optimization opportunities

• Key Market Characteristics
  - Market volume
  - VM type
  - Term duration
  - Time-on-market
  - Comparison with on-demand and spot
Market Volume across Regions

us-east-1 and us-west-2 are largest regions
Market Volume across Regions

Lower market volume may increase risk of using RIM
Market Volume by VM Type

Instance Type

Average Market Volume (#instances listed)

Instances  

ECUs  

us-east-1

Average Market Volume (#ECUs listed)

0  2K  4K  6K  8K

0  2K  4K  6K  8K

Instances

ECUs

c4.large  c5.large  m4.large  i3.xlarge  c5.4xlarge  r5.large  r4.large  c5d.large  m5.2xlarge  c5d.9xlarge

Average Market Volume (#instances listed)

c4.large and c5.large are most popular VM types
Market Volume by VM Type

RIM lagging indicator of instance type popularity
Listing Volume vs. Term Duration

Short and long term durations more plentiful

us-east-1
Discrepancy at 25-36 months may indicate buyer’s remorse
Listing Price (c4.large) vs. Term Duration

Average listing price decreases (nearly) linearly
Time-on-the-Market across Regions

Largest regions have the longest average time on the market

Region

Average Time on the Market (Days)

us-east-1  us-west-2  us-east-2  eu-west-1  eu-central-1  us-west-1  ap-northeast-1  sa-east-1  ap-southeast-1
Time-on-the-Market across Regions

Indicates that demand is less relative to the supply
Time-on-the-Market by VM type

Popular VM types have longest average time on the market
Comparing VM Purchasing Options

Users neither lose nor make money on average in the RIM
Comparing VM Purchasing Options

RIM listings (>=1yr) price close to spot
Conclusion

• Provides a first look at Amazon RIM data
  - Analyzed RIM data from 2018/9 to 2020/5 to reveal key market characteristics
  - Publicly released data at UMass Trace Repository
    ▶ http://traces.cs.umass.edu/index.php/Main/Cloud

• Future work
  - More in-depth analysis of RIM data
  - Use RIM data to mitigate demand risk and optimize long-term cloud costs
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