

# An Evaluation of the Discount Rates for Spot Instances on Amazon EC2

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**Abstract**—This study analyzes and evaluates the discount rates for Spot Instances employed using the new Spot pricing model on Amazon EC2. Spot Instances are virtual computational resources provided as physical computers. The pricing model of Spot Instances changes prices frequently. In 2017, Amazon EC2 dramatically changed its Spot pricing model (Nov-2017 model). This update reduced sudden spikes, seasonal components, and trends. The Nov-2017 model provides Spot Instances at low and predictable prices while adjusting gradually based on long-term trends in supply and demand, saving consumers up to 90% off the On-Demand Instance prices. For the Nov-2017 model’s minimum discount rates, mean discount rates, and fluctuation ranges of discount rates from the On-Demand prices are evaluated. The results show that distribution registering 70% to 90% is the most frequent, which is more than half the Spot Instances.

**Keywords**—Amazon EC2, Spot Instance, Spot price

## I. INTRODUCTION

Cloud computing has become increasingly popular with most companies using cloud services. Cloud computing allows users to reduce both the cost and time needed to construct such systems.

Amazon Elastic Compute Cloud (Amazon EC2) is a service on Amazon Web Service (AWS) that provides Spot Instances. Spot Instances allow consumers to execute jobs at a low price. Spot Instances can be at prices up to 90% lower than On-Demand Instances. However, Spot prices change frequently. Figure 1 shows an example of Spot and On-Demand prices over a three-month period beginning May 29, 2020 and ending August 27, 2020. Executing jobs using Spot Instances is unstable. When consumers use Spot Instances, they set a bidding price. If the bidding price exceeds the Spot price, consumers can use Spot Instances. However, if the Spot price exceeds the bidding price, consumers cannot use Spot Instances. Previously, Spot prices changed drastically and were prone to sudden spikes, making it difficult to predict these Spot price changes. Detailed bidding strategies were therefore needed.

On November 28, 2017, Amazon EC2 dramatically changed the Spot pricing model with the objective of making Spot Instances easier to use. Spot price changes will be loose and extreme spikes are removed [1]. To develop Spot price bidding strategies, we must analyze the Spot price fluctuation. Baughman et al. showed that the Spot Instances were cheaper than On-Demand Instances for at least one month and, in many cases, indefinitely [2]. When consumers request Spot Instances after this implementation, they fundamentally do not

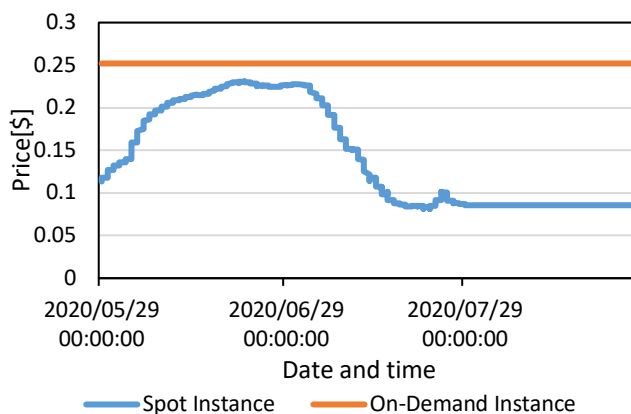


Figure 1: Spot price changes and On-Demand price of c4.xlarge in the Tokyo region

have to set a bid price. Bid prices are prepared as an advanced option, so consumers can set as needed. When using unstable approaches such as Spot Instances, it is important to consider money-time-value tradeoffs. If consumers request Spot Instances while considering these tradeoffs, appropriate bidding strategies are necessary.

Karunakaran and Sundarraj proposed four bidding strategies that bid close to the reserved instance price, above the mean Spot price (which is deduced from the Spot price history), close to the On-Demand price, or above the On-Demand price [3]. Khandelwal et al. analyzed seven bidding strategies that bid at the minimum Spot price, the mean Spot price, the maximum Spot price, higher than the current Spot price, at 70% of the On-Demand price, at the On-Demand price, and above the On-Demand price [4]. After the implementation of the new model, Spot price fluctuation was reduced. Bidding strategies must therefore be developed that suit this new model. In this study, we analyze and evaluate the Spot price characteristics for proposing new bidding strategies that consider the money-time-value tradeoffs.

## II. EVALUATION

We evaluated the discount rates of Spot prices from On-Demand prices and clarified the Spot Instance characteristics. Amazon EC2 provides Spot price history for a period of 90 days. We used the Spot price history for a period of about two-months, beginning Jun 1, 2020 and ending July 31, 2020, collected by the Amazon EC2 Spot price API. Amazon EC2 Spot price API provides only the timestamp at which Spot price changes occur and the Spot price at that time, so it is

necessary to fill between the time stamps manually. Timestamps are expressed in Universal Time Coordinated (UTC). In this study, we fixed the product as Linux/UNIX and the region as Tokyo. For our evaluation element, we used the mean Spot price, maximum Spot price, and minimum Spot price from data collected over approximately two months. We used 702 data of Spot Instances because the number of instance types is 277 and each instance type has prices in two or three regions. We calculated and analyzed discount rates and fluctuation ranges from the On-Demand price for each Spot Instance. The discount rates are represented by following equation.

$$\text{Discount rate}[\%] = \left( 1 - \frac{\text{Spot price}[\$]}{\text{On-Demand price}[\$]} \right) * 100$$

In the next section, we discuss the distribution of Spot price discount rates.

### III. RESULTS

Figure 2 shows the distribution of the minimum discount rates and Table 1 shows the rates of the number corresponding to the minimum discount rates. The distribution registering 70% to 90% occurred most frequently, more than 60% of the Spot Instances. In addition, the rates at which the minimum discount rates are over 70% are about 64% and the rates at which the minimum discount rates are over 50% are about 82%. On the other hand, the rates at which the minimum discount rates are below 30% are about 15% and the rates at which the minimum discount rates are about 0% are 14% for all. Surprisingly, there is only one Spot Instance in this range, but the Spot Instance indicates a price over the On-Demand price.

Figure 3 shows the distribution of the fluctuation range of the discount rates and Table 2 shows the rates of the number corresponding to the fluctuation of the discount rates. About 84% of the Spot Instances distribute the fluctuation in a range of 0% to 10%. Furthermore, the rates where the distribution of the discount rates are below 1 are about 70% of all. Thus, most Spot Instances show little change. Under the influence of a Spot Instance that indicates a price over the On-Demand price, there is also a Spot Instance that indicates a fluctuation range over 100%.

These two results indicate that consumers can use most Spot Instances at a discount over 50% of the On-Demand price and without large price fluctuation.

### IV. DISCUSSION

Our results show that consumers can use Spot Instances that are less than the On-Demand price, except for one. Bidding the same as the On-Demand price is possible for consumers because these Spot Instances are relatively stable. However, it is advisable for consumers to use On-Demand Instances because of their stability. Spot Instances change price frequently and provide cost-time-value tradeoffs. Consumers can use Spot Instances at a price discount of 50% of the On-Demand price and about 64% of the Spot Instances are discounted over 70% from the On-Demand price. Considering the tradeoffs, it is possible for consumers to use methods in accordance with their goals.

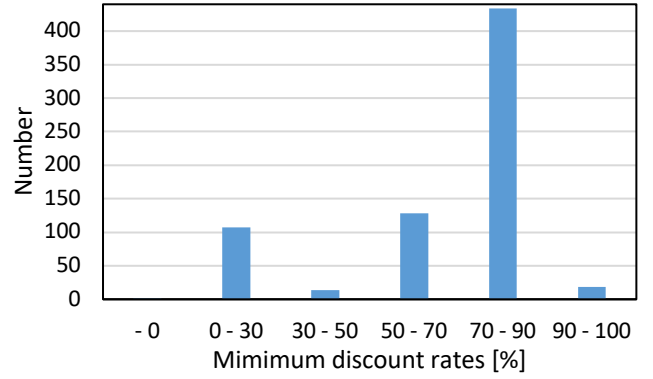


Figure 2: Distribution of minimum discount rates

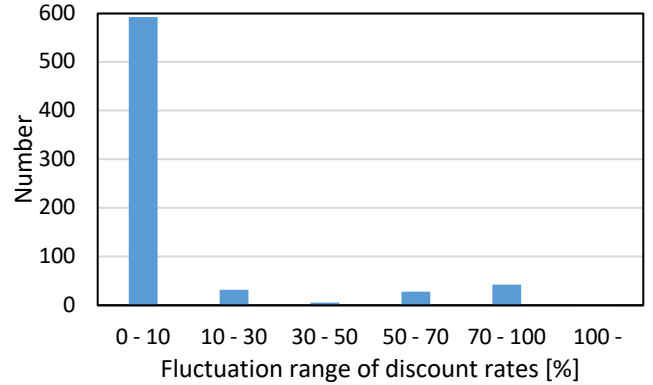


Figure 3: Distribution of fluctuation range of discount rates

The second result demonstrates that consumers can use most Spot Instances at almost the same price. If consumers see that the price is unchanging according to the Spot price history, consumers can use Spot Instances by bidding a little more than the maximum Spot price in the history. The success of this prediction may change depending on the period of the Spot price history used.

In this study, we did not consider the time factor and paid attention to the value obtained by the Spot price history. Although promising, we must confirm whether a prediction using the Spot price history is successful or consider the influence of the time factor.

### V. CONCLUSION

In this study, we analyzed and evaluated Spot prices with the discount rates from the On-Demand price and the minimum discount rates of Spot prices from the On-Demand price. We determined the features of the minimum discount rates and observed the fluctuation range of discount rates for Spot prices. However, we need to confirm what can be used as a predictor from the results obtained in this study. In some cases, it is necessary to use the time factor to make an informed prediction of the bidding price or the bidding price prediction may change depending on the period of the Spot price history used.

As our future work, we will attempt to develop a system that automatically calculates and proposes bidding strategies for

Table 1: Rates of the number corresponding to minimum discount rates

Minimum discount rates [%]	Number	Rates [%]
- 0	1	0.14
0 - 30	107	15.24
30 - 50	14	1.99
50 - 70	128	18.23
70 - 90	434	61.82
90 - 100	18	2.56

Table 2: Rates of the number corresponding to fluctuation range of discount rates

Fluctuation range of discount rates [%]	Number	Rates [%]
0 - 10	593	84.47
10 - 30	32	4.56
30 - 50	6	0.85
50 - 70	28	3.99
70 - 100	42	5.98
100 -	1	0.14

easier to use Spot Instances. To do so, we will clarify the time factor or its influences.

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