



# **Immersion Day**

## Getting Started with Amazon API Gateway

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**January, 2019**

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## Overview

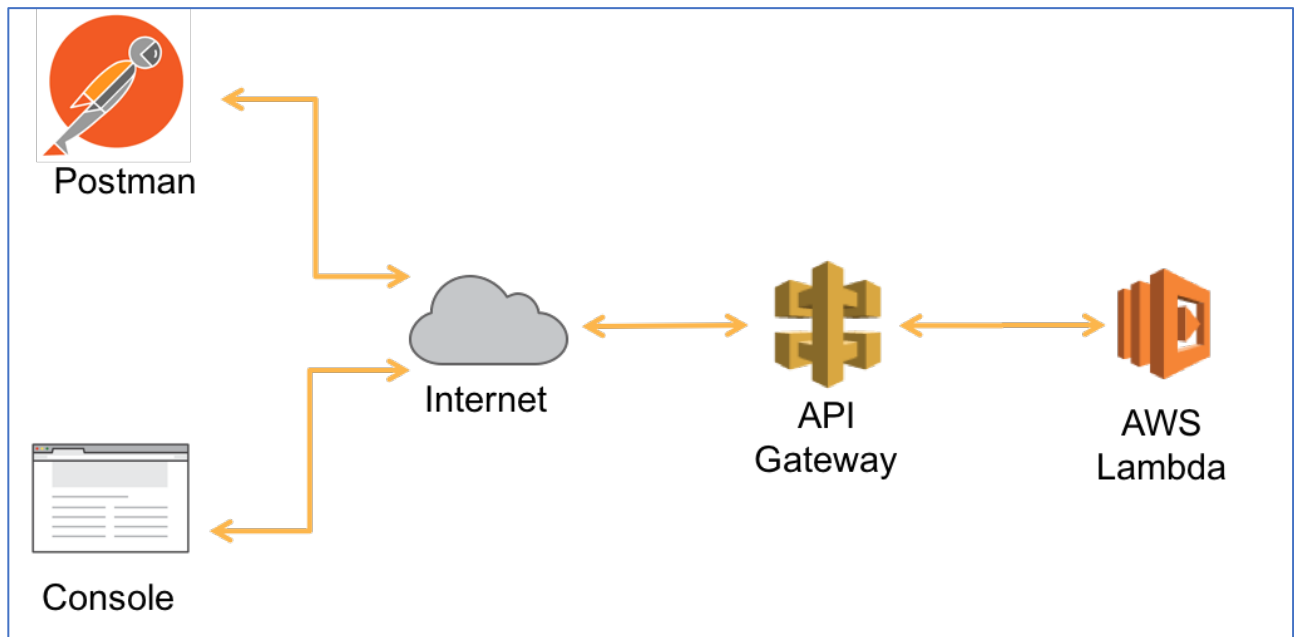


Figure 1: Lab Architecture

Amazon API Gateway is a fully managed service that makes it easy for developers to create, publish, maintain, monitor, and secure APIs at any scale. API Gateway acts as a “front door” for applications to access data, business logic, or functionality from your back-end services, such as workloads running on Amazon Elastic Compute Cloud (Amazon EC2), code running on AWS Lambda, or any Web application.

In lab 1, you will create an API that invokes a lambda function to calculate the price of a house (price per square foot). In the first part of the lab, you will deploy a pre-defined sample lambda function and create the back-end API. You will test your APIs using either the API Gateway console or Postman. In lab 2, you will learn how to cache service response, throttle requests, and create various usage plans. The overall architecture for the lab is depicted in figure 1 above.

## Lab Pre-Requisites

In order to complete this immersion day lab, you'll need an AWS Account with access to create AWS IAM, S3, Cognito, Lambda, and API Gateway. The code and instructions in this workshop assume only one student is using a given AWS account at a time.

- Install AWS CLI - Follow the [AWS CLI Getting Started](#) guide to install and configure the CLI on your machine.
- Deploy CostCaluculator and MedianPriceCalculator Lambda Functions – See Appendix for deployment instructions
- Install Postman - <https://www.getpostman.com/apps>

## Lab 1: Creating Your First API

1. Sign into the AWS Management Console and open API Gateway console at <https://console.aws.amazon.com/apigateway>
2. **Ensure that you are in “N. Virginia” region**
3. If this is your first API, you will see the Amazon API Gateway welcome page. Click on ‘Get Started’. Otherwise, select ‘Create API’.

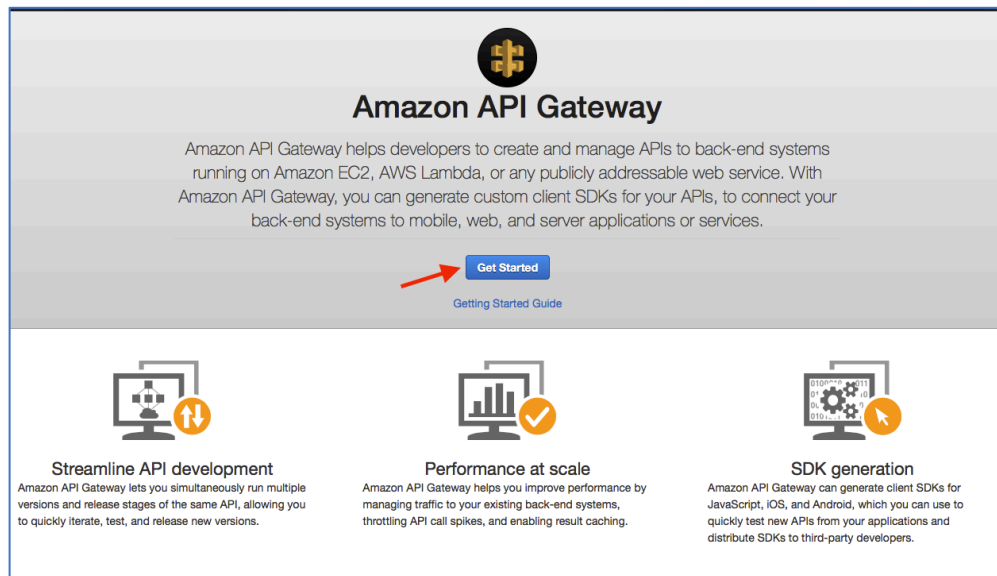


Figure 2: API Gateway Main Console

4. Select **“REST”**
5. Select **“New API”**
6. Under Settings, Enter the following values:  
API Name: **calculatePrice**  
Description: **Calculates the price of a house per square meters**  
Endpoint Type: **Edge Optimized**

## Serverless Immersion Day Getting Started with Amazon API Gateway

The screenshot shows the 'Create new API' page in the AWS Management Console. At the top, there's a heading 'Create new API' and a sub-header 'In Amazon API Gateway, an API refers to a collection of resources and methods that can be invoked through HTTPS endpoints.' Below this, there are four radio buttons: 'New API' (selected), 'Clone from existing API', 'Import from Swagger', and 'Example API'. A 'Settings' section follows, with the instruction 'Choose a friendly name and description for your API.' It contains three fields: 'API name\*' with the value 'calculatePrice', 'Description' with the value 'Calculates the price of a house per', and 'Endpoint Type' with a dropdown menu showing 'Edge optimized'. At the bottom left, there's a note '\* Required'. At the bottom right, there is a blue 'Create API' button.

Figure 3: Creating a new API

7. Click **'Create API'**
8. Under *Actions*, choose **'Create Resource'**

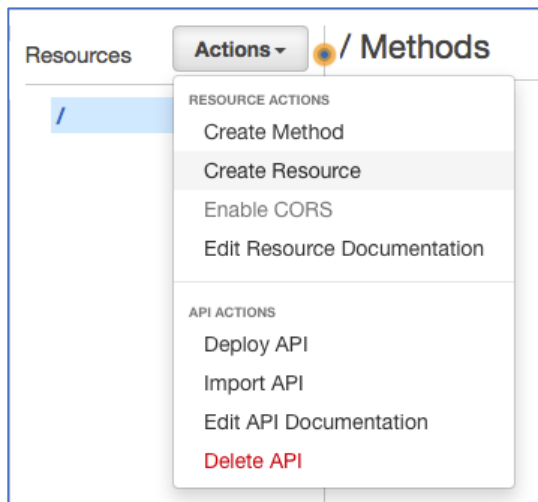


Figure 4: Creating a new resource

9. Enter the following values:  
Resource Name: **pricePerMeter**  
Resource Path: **pricePerMeter**
10. Click **'Create Resource'**

Resources Actions ▾ New Child Resource

Use this page to create a new child resource for your resource.

Configure as [proxy resource](#) ☐ ⓘ

Resource Name\* pricePerMeter

Resource Path\* / pricepermeter

You can add path parameters using brackets. For example, the resource path `{username}` represents a path parameter called 'username'.  
Configuring `/ {proxy+}` as a proxy resource catches all requests to its sub-resources. For example, it works for a GET request to `/foo`. To handle requests to `/`, add a new ANY method on the `/` resource.

Enable API Gateway CORS ☐ ⓘ

\* Required

Cancel Create Resource

Figure 5: Resource Name and path

## 11. Select *Actions*, choose ‘Create Method’

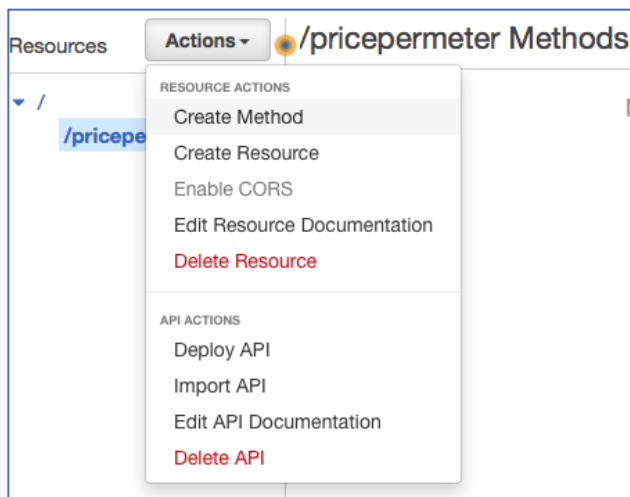


Figure 6: Creating a method

12. Choose ‘Post’ and Click on *check icon* to confirm.

13. Under the *Post* method, Choose the following values:

Integration Type: **Lambda Integration**

Lambda Region: **us-east-1**

Lambda Function: **serverless-immersion-day-stac-CalculateCostPerUnit-XX**  
(type **serverless** and let the box populates)

14. Click **Save**.

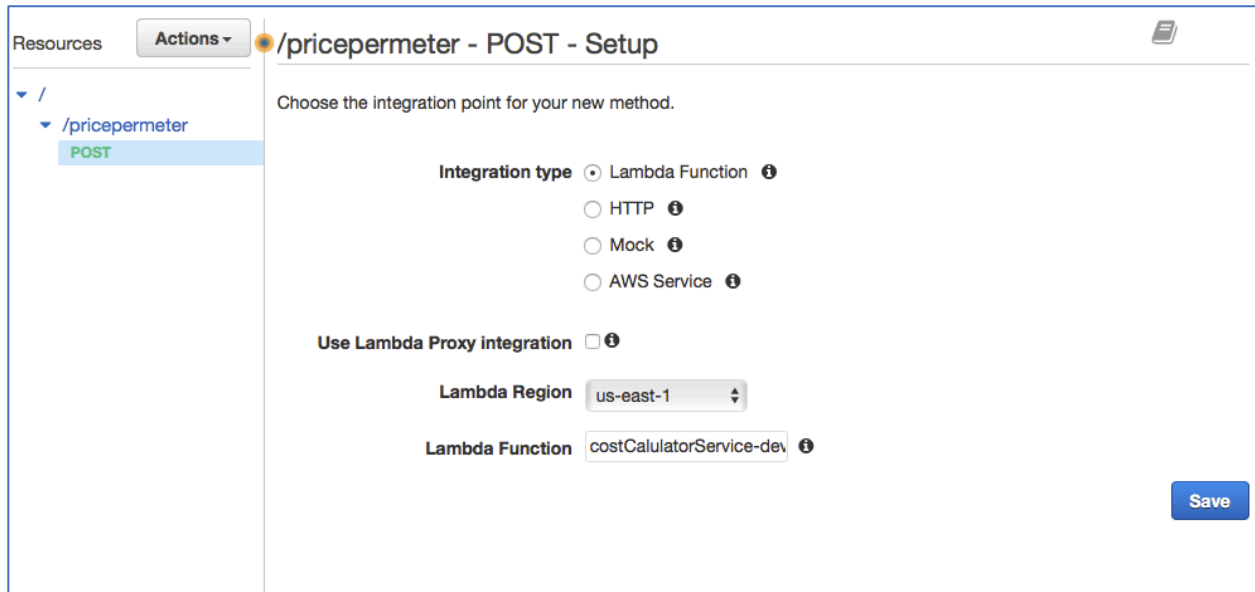


Figure 7: Configuring POST action

15. In the dialogue box, “Add Permission to Lambda Function”, Click ‘**OK**’.

You have now configured your API to call the ‘costCalculator’ lambda function. The API Gateway pane shows the request and response flow of data.

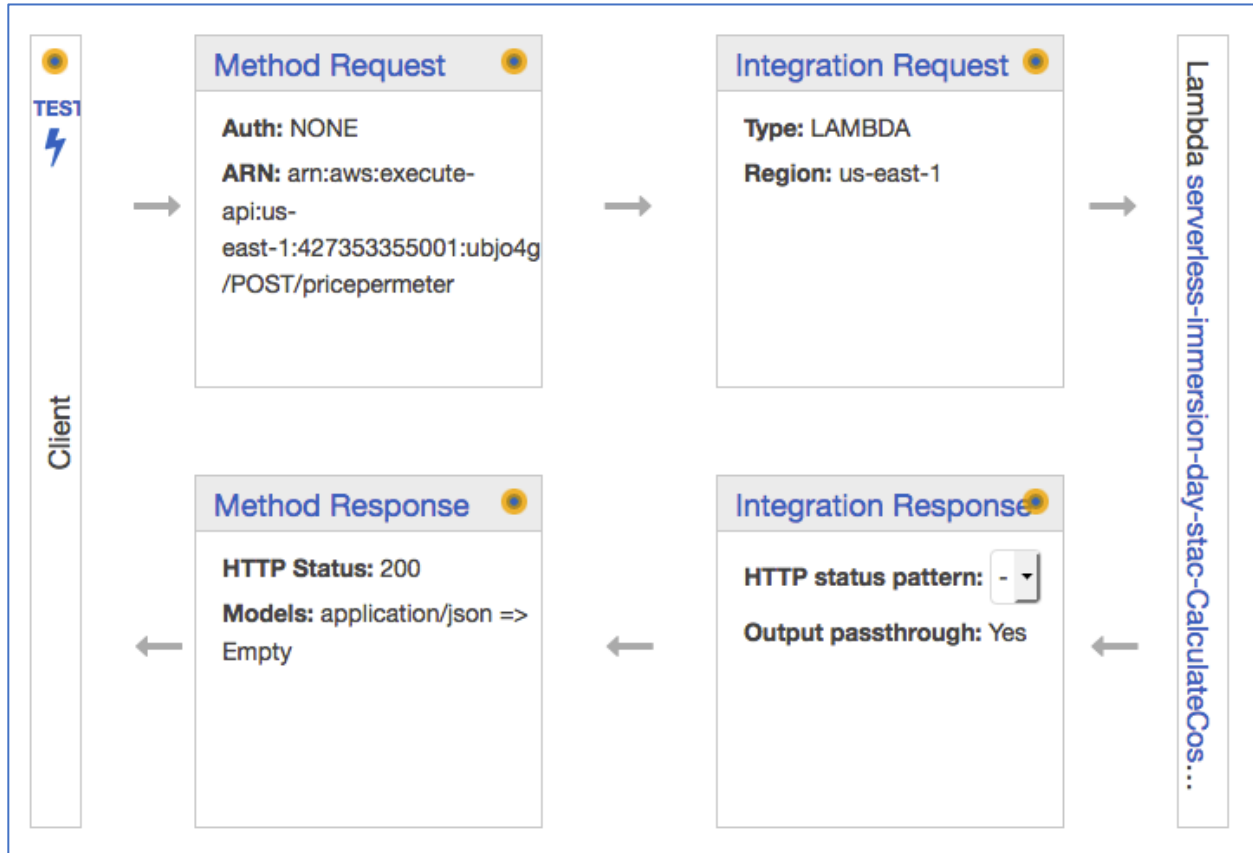


Figure 8: API Gateway console pane

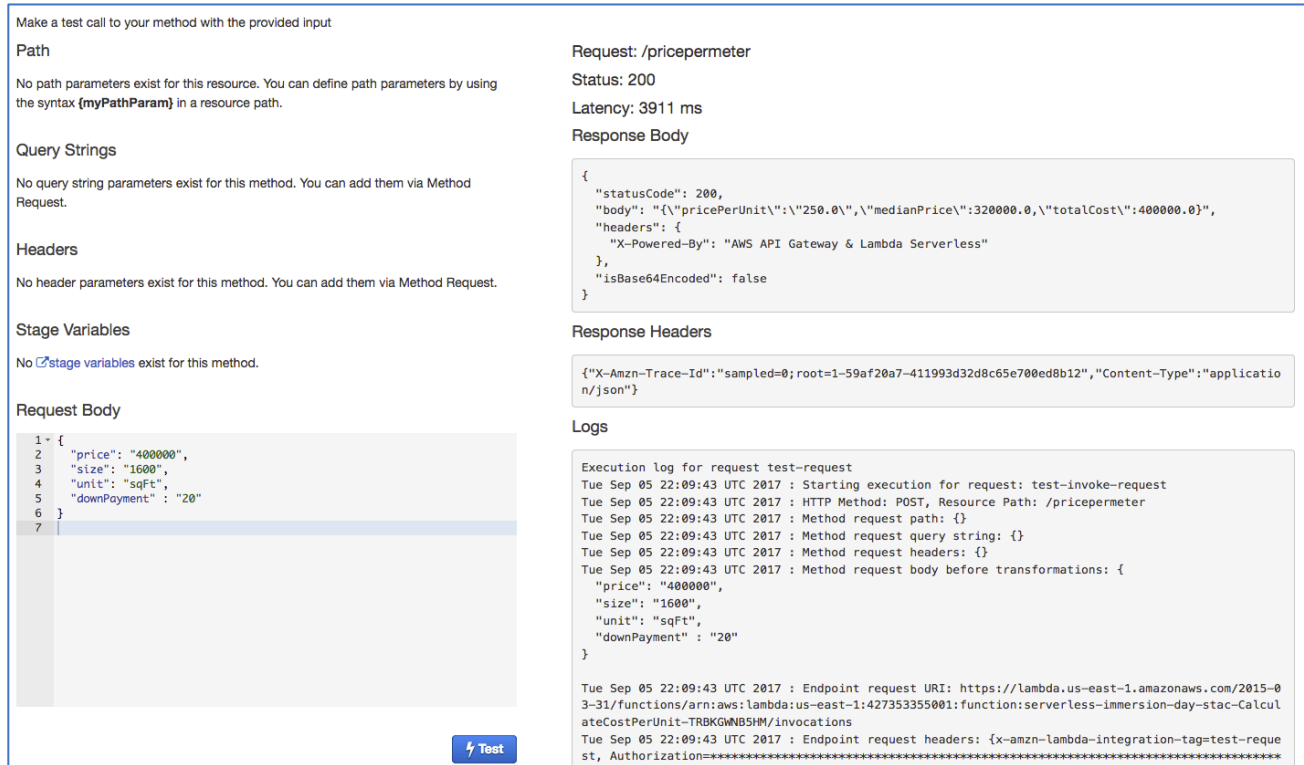
16. Click on the 'Test' icon to provide a sample request message.
17. Copy and Paste the following JSON Sample in the 'Request Body' section

```
{
  "price": "400000",
  "size": "1600",
  "unit": "sqFt",
  "downPayment" : "20"
}
```
18. } Click 'Test'

Please note the Response Body with a "status code" of **200**. The body of the response contains the price per unit and the total cost. The header of the response along with the message body is composed by the lambda function. The testing page also shows a complete request/response log.



## Serverless Immersion Day Getting Started with Amazon API Gateway



Make a test call to your method with the provided input

**Path**

No path parameters exist for this resource. You can define path parameters by using the syntax `{myPathParam}` in a resource path.

**Query Strings**

No query string parameters exist for this method. You can add them via Method Request.

**Headers**

No header parameters exist for this method. You can add them via Method Request.

**Stage Variables**

No [stage variables](#) exist for this method.

**Request Body**

```
1 {
2   "price": "400000",
3   "size": "1600",
4   "unit": "sqFt",
5   "downPayment": "20"
6 }
7
```

**Request:** /pricepermeter

**Status:** 200

**Latency:** 3911 ms

**Response Body**

```
{
  "statusCode": 200,
  "body": "{\"pricePerUnit\": \"250.0\", \"medianPrice\": 320000.0, \"totalCost\": 400000.0}\",
  \"headers\": {
    \"X-Powered-By\": \"AWS API Gateway & Lambda Serverless\"
  },
  \"isBase64Encoded\": false
}
```

**Response Headers**

```
{\"X-Amzn-Trace-Id\": \"sampled=0; root=1-59af20a7-411993d32d8c65e700ed8b12\", \"Content-Type\": \"application/json\"}
```

**Logs**

Execution log for request test-request

```
Tue Sep 05 22:09:43 UTC 2017 : Starting execution for request: test-invoke-request
Tue Sep 05 22:09:43 UTC 2017 : HTTP Method: POST, Resource Path: /pricepermeter
Tue Sep 05 22:09:43 UTC 2017 : Method request path: {}
Tue Sep 05 22:09:43 UTC 2017 : Method request query string: {}
Tue Sep 05 22:09:43 UTC 2017 : Method request headers: {}
Tue Sep 05 22:09:43 UTC 2017 : Method request body before transformations: {
  \"price\": \"400000\",
  \"size\": \"1600\",
  \"unit\": \"sqFt\",
  \"downPayment\": \"20\"
}

Tue Sep 05 22:09:43 UTC 2017 : Endpoint request URI: https://lambda.us-east-1.amazonaws.com/2015-03-31/functions/arn:aws:lambda:us-east-1:427353355001:function:serverless-immersion-day-stac-CalculateCostPerUnit-TRBKGMNB5HM/invocations
Tue Sep 05 22:09:43 UTC 2017 : Endpoint request headers: {x-amzn-lambda-integration-tag=test-request, Authorization=*****}
```

Figure 9: Testing API

Notice that the lambda service returned the total cost, but did not account for the down payment. In the next section, we will transform the message to pass the down payment amount to the lambda function.

### Message Transformation

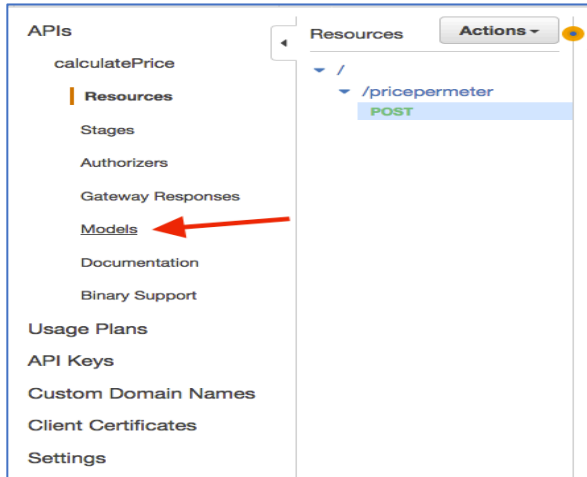
In API Gateway, a mapping template is used to transform data from one format to another. A JSON path expressions can be used to map and transform the integration payload to any desired format. In addition, a model (schema) can be created to define the structure of a message payload. Having a model also enables you to generate an SDK that can be used by the client application to send properly formatted messages.

In this section, you will first create a model to represent the schema of the incoming request and response messages. Then you will validate and transform the incoming request message to match the downstream service (lambda) specification. The returned response message will also be formatted to properly capture the unit metrics.

### Building a Model

1. In the box that contains the name of the API (calculatePrice), select **Models**.

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Getting Started with Amazon API Gateway



2. Click 'Create'.
3. Enter the following information:

Model name: **costCalculatorRequest**

ContentType: **application/json**

Model Description: **CostCalculator incoming request schema**

Model Schema: Copy and Paste the following:

```
{
  "$schema": "http://json-schema.org/draft-04/schema#",
  "title": "costCalculatorRequestModel",
  "type": "object",
  "properties": {
    "price": { "type": "number" },
    "size": { "type": "number" },
    "unit": { "type": "string" },
    "downPayment": { "type": "number" }
  }
}
```

## Serverless Immersion Day Getting Started with Amazon API Gateway

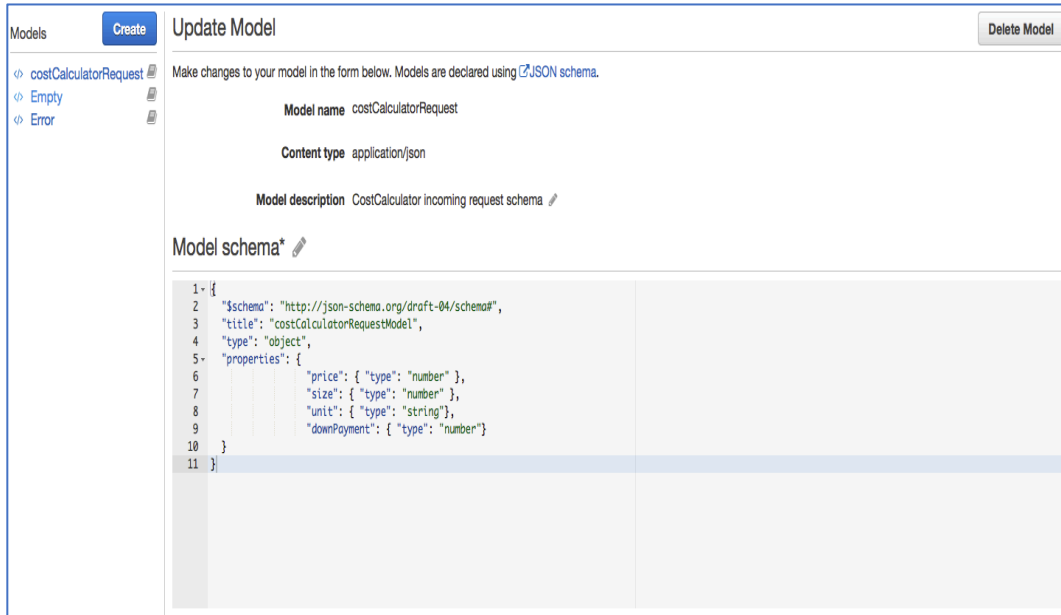


Figure 10: Updating Model

#### 4. Click **Create model**.

Now that the models are created, the next step is to transform the incoming request and response messages.

#### Transform Request Payload

1. Go back to the '**CalculatePrice**' API and click on the '**POST**' action.
2. From the Gateway pane, click on '**Integration Request**'

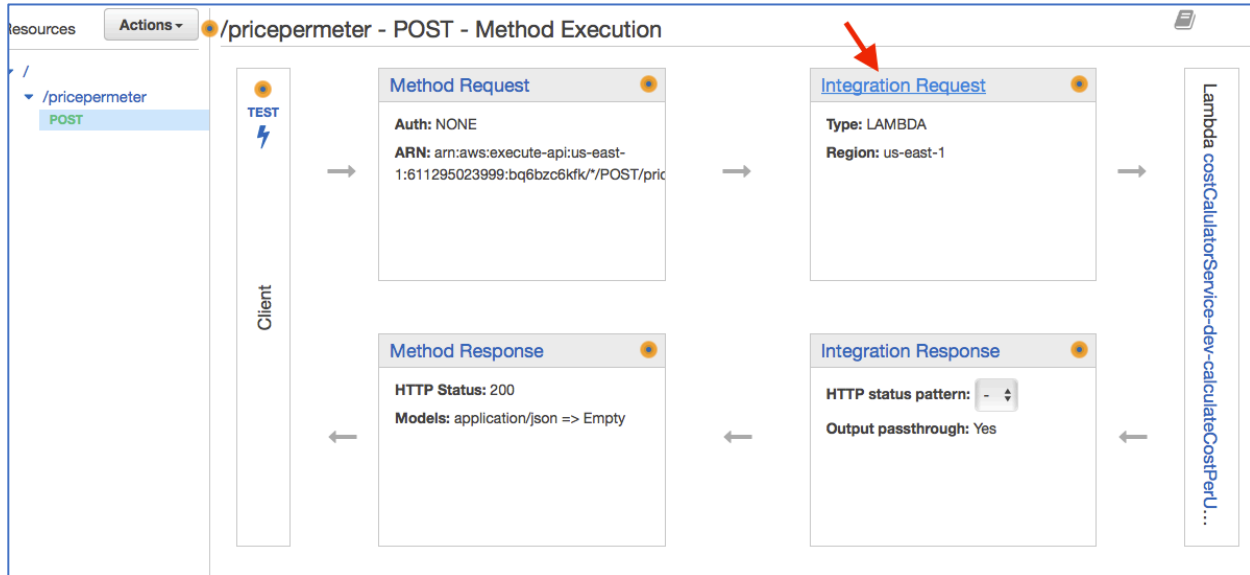


Figure 11: Integration Request

3. From the Integration Request pane, expand the 'Mapping Templates'
4. Select 'When there are no templates defined (recommended)'
5. Click on 'Add mapping template'
6. Type 'application/json' for the Content-Type. Select 'check' mark.
7. Under the 'Generate Template', select 'costCalculatorRequest' model
8. Update the template as follows:

```
#set($inputRoot = $input.path('$'))
{
  "price" : "$inputRoot.price",
  "size" : "$inputRoot.size",
  "unit" : "$inputRoot.unit",
  "downPaymentAmount" : $inputRoot.downPayment
}
```

9. Click Save

The first statement `#set($inputRoot = $input.path('$'))` uses a JSONPath expression and returns an object representation of the result. This allows you to access and manipulate elements of the payload natively in Apache Velocity Template Language (VTL).

After the 'inputRoot' variable is assigned to the root of the request, we can map the value of price, size and unit into the appropriate fields. **Notice that the last statement is mapping the value of 'downPayment to a new attribute called 'downPaymentAmount'.** The downstream lambda function uses the downPaymentAmount to calculate the total price. (i.e. `totalPrice = price + downPaymentAmount`).

The next step is to map the integration response. An API Gateway response is identified by a response type defined by API Gateway. The response consists of an HTTP status code, a set of

additional headers that are specified by parameter mappings, and a payload that is generated by a non-VTL mapping template

Similar to the request mapping, create the mapping template for the response payload. Perform the following:

1. Go back to the ‘**CalculatePrice**’ API and click on the ‘**POST**’ action.
2. From the API Gateway pane, select ‘**Integration Response**’.
3. Click on ‘**Integration Response**’

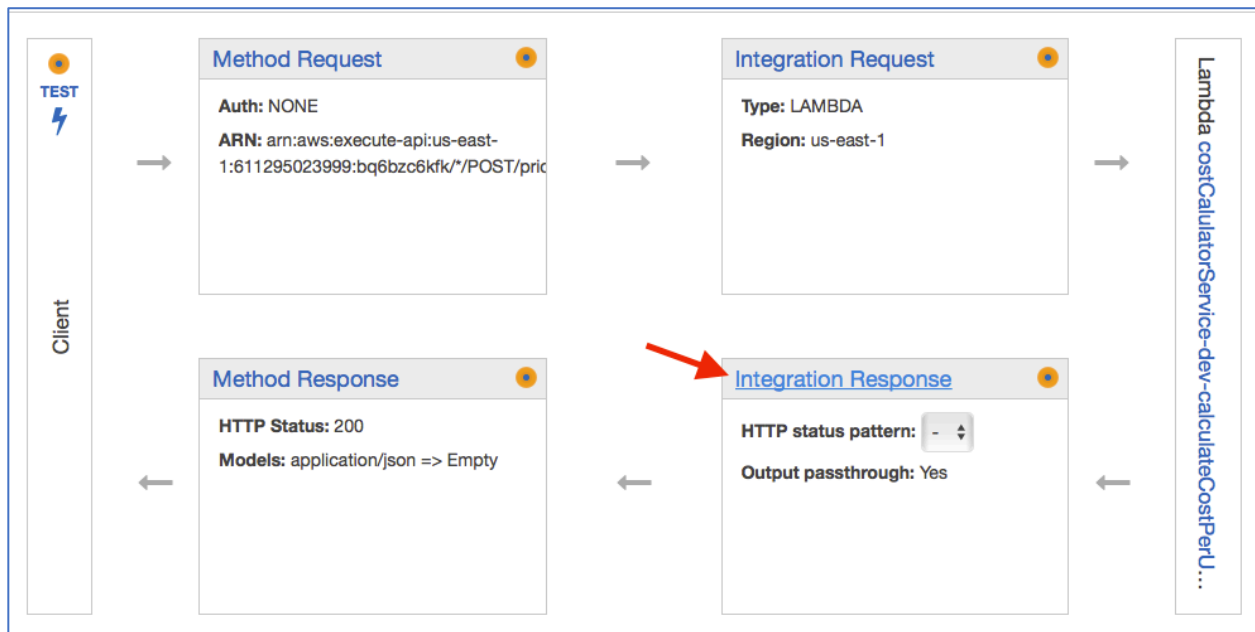


Figure 12: Integration Response

4. **Expand** the 200 Method response row
5. Expand the ‘**Mapping Templates**’
6. Click on ‘**application/json**’ Content-Type
7. On “Generate template” dropdown, choose ‘**Method Request Passthrough**’
8. Click **Save**

# Serverless Immersion Day

## Getting Started with Amazon API Gateway

Lambda Error Regex	Method response status	Output model	Default mapping
<div><div>▼</div><div>-</div></div>	200		Yes
Map the output from your Lambda function to the headers and output model of the 200 method response.			
<div>Lambda Error Regex<div>default</div></div>			
<div>Content handling<div>Passthrough</div></div>			
			<div>Cancel</div> <div>Save</div>
Header Mappings			
Body Mapping Templates			
<div>Content-Type</div> <div>application/json</div> <div>+ Add mapping template</div>	<div>application/json</div> <div>Generate template</div> <div><pre>1 ## See Models 2 ## -ref costCalculatorRequest 3 ## This Empty 4 ## and Error 5 #set(\$inputJson = \$input.json('\$')) 6 { 7   "body-json" : \$input.json('\$'), 8   "params" : { 9     #foreach(\$type in \$allParams.keySet()) 10       #set(\$params = \$allParams.get(\$type)) 11       "type" : { 12         #foreach(\$paramName in \$params.keySet()) 13           \$paramName : "\$util.escapeJavaScript(\$params.get(\$paramName))" 14         #if(\$foreach.hasNext),#end 15       } 16     #if(\$foreach.hasNext),#end 17   } 18 }</pre></div> <div>Cancel</div> <div>Save</div>		

Figure 13: Method Request - Passthrough

In the response mapping, we have chosen to pass through the response content from lambda without making any further modifications. The 'method request passthrough' is a pre-defined template that maps the request header, body, parameters and context. The \$context variable holds all the contextual information of your API call.

1. Go back to your 'calculatePrice' API and click on the 'POST' method to test your API.
2. Click on the '**Test**' icon to provide a sample request message.
3. Copy and Past the following JSON Sample in the '**Request Body**' section

```
{
  "price": "400000",
  "size": "1600",
  "unit": "sqFt",
  "downPayment" : "20"
}
```

4. } Click on **'Test'**

## Serverless Immersion Day

### Getting Started with Amazon API Gateway

The screenshot displays the Amazon API Gateway console interface for a resource. On the left, the 'Path' section indicates no path parameters exist. Below it, 'Query Strings' and 'Headers' sections also show no parameters exist. The 'Stage Variables' section shows no variables exist. The 'Request Body' section contains a JSON object with the following structure:

```
1 {
2   "price": "400000",
3   "size": "1600",
4   "unit": "sqft",
5   "downPayment": "20"
6 }
7
```

On the right, the 'Request' section shows the path `/pricepermeter`, status `200`, and latency `94 ms`. The 'Response Body' section displays a JSON object with the following structure:

```
{
  "body-json": {
    "statusCode": 200,
    "body": "{\"pricePerUnit\":\"250.0\",\"totalCost\":400020.0}",
    "headers": {
      "X-Powered-By": "AWS API Gateway & Lambda"
    },
    "isBase64Encoded": false
  },
  "params": {
    "path": {},
    "querystring": {},
    "header": {}
  },
  "stage-variables": {},
  "context": {
    "account-id": "611295023999",
    "api-id": "bq6bzc6kfk",
    "api-key": "test-invoke-api-key",
    "authorizer-principal-id": "",
    "caller": "AIDAI04AZ3P5D75J3557K",
    "cognito-authentication-provider": "",
    "cognito-authentication-type": "",
    "cognito-identity-id": "",
    "cognito-identity-pool-id": "",
    "http-method": "POST",
    "stage": "test-invoke-stage",
    "source-ip": "test-invoke-source-ip",
    "user": "AIDAI04AZ3P5D75J3557K",
    "user-agent": "Apache-HttpClient/4.5.x (Java/1.8.0_131)",
    "user-arn": "arn:aws:iam:611295023999:user/mustafa",
    "request-id": "test-invoke-request",
    "resource-id": "b8m83w",
    "resource-path": "/pricepermeter"
  }
}
```

Below the response body, the 'Response Headers' section shows the following header:

```
{"X-Amzn-Trace-Id":"sampled=0;root=1-5991ec49-d6c37a63916e364236c25f9a","Content-Type":"application/json"}
```

Figure 14: Message Response

Notice that the ‘downPayment’ amount was added to the price. The response also contains the header and context attributes.

### Request Validation

Request validation is used to ensure that the incoming request message is properly formatted and contains the proper attributes. You can set up request validators in an API's Swagger definition file and then import the Swagger definitions into API Gateway. You can also set them up in the API Gateway console or by calling the API Gateway REST API, AWS CLI, or one of the AWS SDKs.

The API Gateway console lets you set up the basic request validation on a method using one of the three validators:

- **Validate body:** This is the body-only validator.
- **Validate query string parameters and headers:** This is the parameters-only validator.
- **Validate body, query string parameters, and headers:** This validator is for both body and parameters validation.

In this section, we will use the console to setup request validation and validate only the body.

1. Select '**CalculatePrice**' API and choose the 'POST' method.
2. Choose **Method Request**.

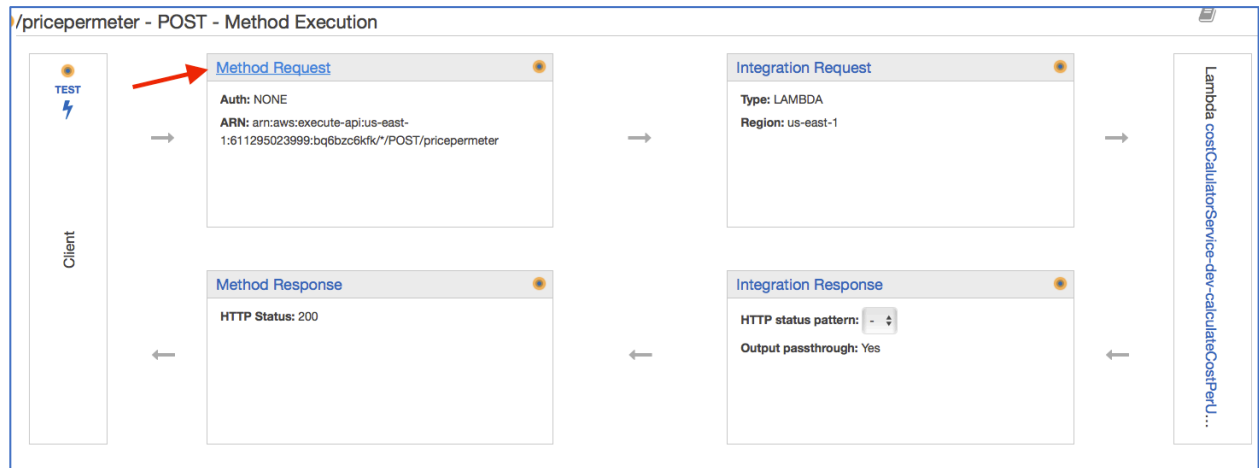


Figure 15: Method Request

3. Choose the pencil icon of **Request Validator** under **Settings**.
4. Choose **validate body** from the **Request Validator** drop-down list and then click the check mark icon to save your choice.



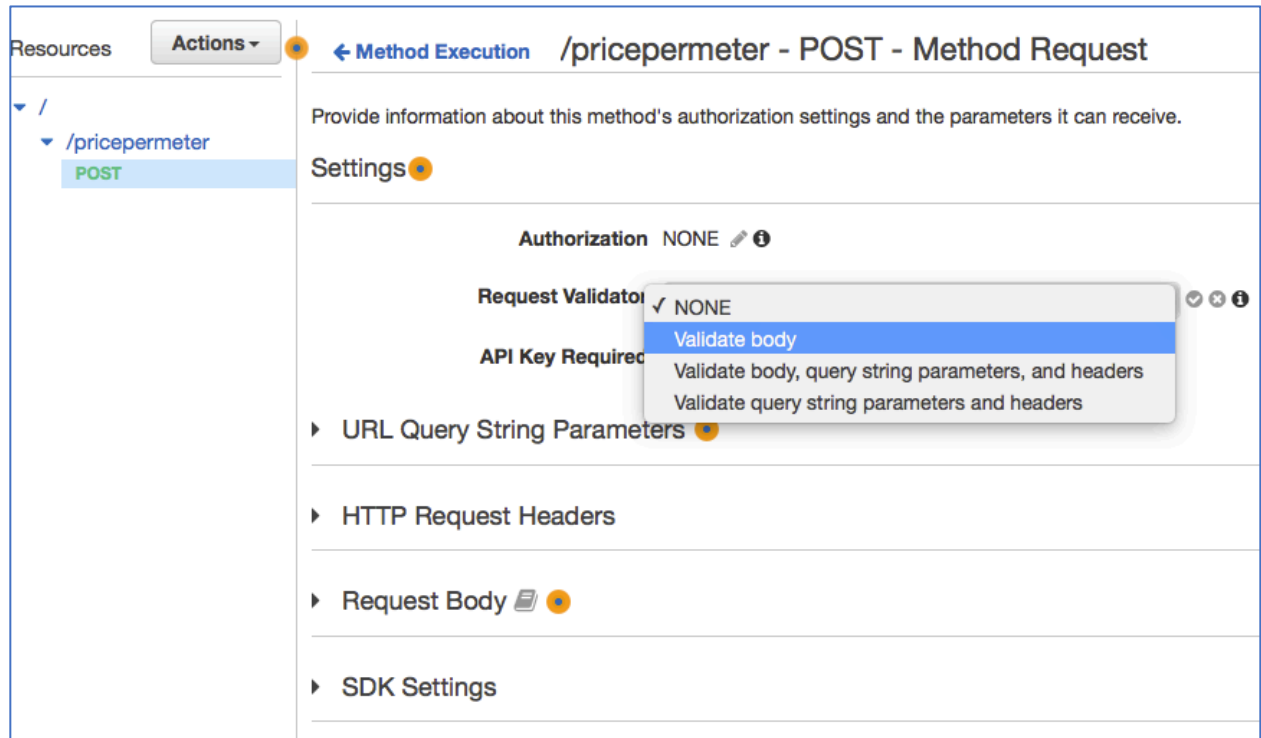
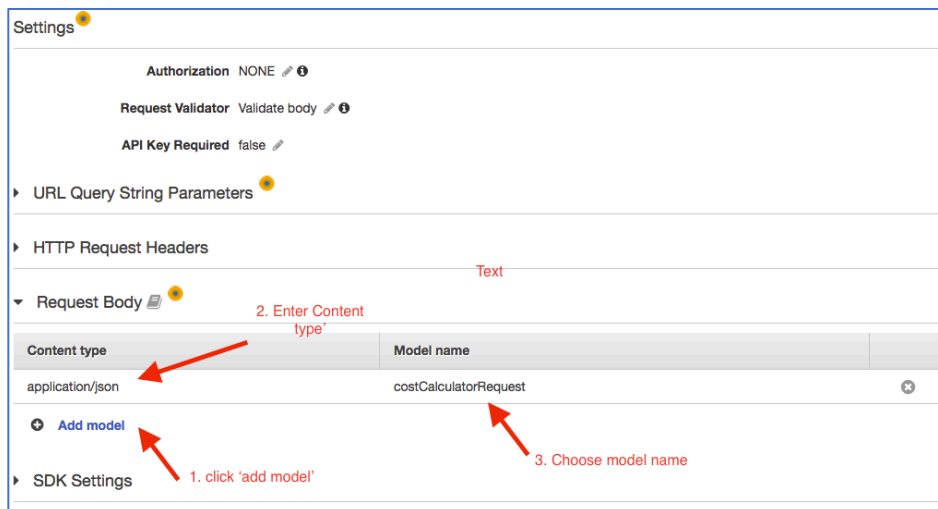


Figure 16: Message Validation

5. Expand 'Request Body'
6. Click 'Add model'
7. Enter 'application/json' for Content Type
8. Choose 'costCalculatorRequest' for the model name
9. Click the 'check' icon to confirm.



Go back to the API Gateway console and select the 'POST' integration method to test out the API.

1. Click on the ‘Test’ icon to provide a sample request message.
2. Copy and Paste the following JSON Sample in the ‘Request Body’ section

```
{  
  "price": "400000",  
  "size": "1600",  
  "unit": "sqFt",  
  "downPayment" : "20"  
}
```

3. } Click on ‘Test’

Notice that this time, the message failed with a message of “Invalid request body”.

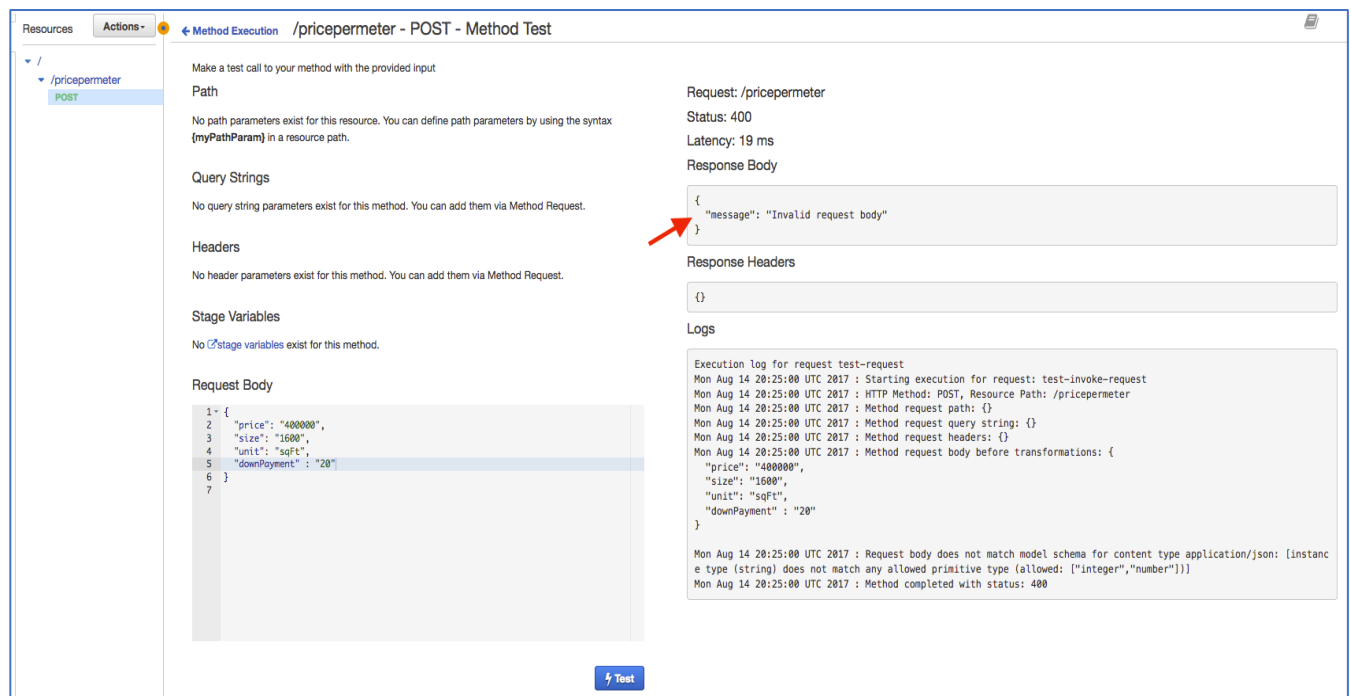


Figure 17: Failed Validation Response

The request failed validation because price, size and downPayment are defined as ‘number’ in our model/schema. Hence, remove the string quotes (“ ”) from price, size, and downPayment and try your request again.

4. Click on the ‘Test’ icon to provide a sample request message.
5. Copy and Paste the following JSON Sample in the ‘Request Body’ section

```
{  
  "price": 400000,  
  "size": 1600,  
  "unit": "sqFt",  
  "downPayment" : 20  
}
```

6. } Click on **‘Test’**

You should see that the normal response is returned by the service.

### Authentication and Authorization

At this point, our API is wide open and we need to protect it by implementing an authentication mechanism. API Gateway supports IAM auth, Cognito User Pools, and custom authorizers written as Lambda function. In this lab, we will leverage Amazon Cognito to have only registered users use our ‘costCalculator’ API.

The first step is to create a Cognito User Pool. A User Pool is our user directory. We can register users in the pool and users can authenticate with their credentials. The outcome of a successful authentication against User Pools is an Open ID Connect-compatible (OIDC) identity token and a JWT access token

1. From the services menu, choose ‘Cognito’ or go to <https://console.aws.amazon.com/cognito>
2. Click on **‘Manage your User Pools’**
3. Click on **‘Create a User Pool’**
4. Enter **‘CostCalculatorUserPool’**

Figure 18 : Creating User Pool

5. Click **‘Step through Settings’**
6. Click on the **App Clients** menu from the left navigation pane
7. Click **‘Add an app Client’**
8. Enter **‘Cost-Calculator-App-Client’** for the name
9. **Uncheck** Generate client Secret
10. Check **‘Enable sign-in API for server-based authentication (ADMIN\_NO\_SRP\_AUTH)’**
11. Leave all other default fields and click **‘Create app client’**.

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**Which app clients will have access to this user pool?**

The app clients that you add below will be given a unique ID and an optional secret key to access this user pool.

**App client name**  
Cost-Calculator-App-Client

**Refresh token expiration (days)**  
30

☐ Generate client secret

☒ Enable sign-in API for server-based authentication (ADMIN\_NO\_SRP\_AUTH) [Learn more.](#)

☐ Only allow Custom Authentication (CUSTOM\_AUTH\_FLOW\_ONLY) [Learn more.](#)

[Set attribute read and write permissions](#)

[Cancel](#) [Create app client](#)

Figure 19: Client App Settings

12. Click on the **‘Review’** item from the navigation pane

13. Leave all the default fields and click **‘Create Pool’**

**Note:** In the user pool screen, make a note of your **Pool ID**

**CostCalculatorUserPool** [Delete pool](#)

**General settings** (selected)

- Users and groups
- Attributes
- Policies
- Verifications
- Message customizations
- Tags
- Devices
- App clients
- Triggers
- App integration
- App client settings
- Domain name
- UI customization
- Resource servers
- Federation
- Identity providers

**Pool Id** us-east-XXXXXXXXXXXX

**Pool ARN** arn:aws:

**Estimated number of users** 0 [Edit](#)

**Required attributes** email [Edit](#)

**Alias attributes** none

**Username attributes** none

**Custom attributes** [Choose custom attributes...](#)

**Minimum password length** 8 [Edit](#)

**Password policy** uppercase letters, lowercase letters, special characters, numbers

**User sign ups allowed?** Users can sign themselves up

Figure 20 : General Settings Pool ID

14. Click on **‘App client settings’**

## Serverless Immersion Day Getting Started with Amazon API Gateway

Note: Make a note of your **App Client ID**

The screenshot shows the Amazon Cognito console. On the left, the 'App integration' section is expanded, and 'App client settings' is selected. The main content area shows the settings for the 'App client Cost-Calculator-App-Client'. The 'App client ID' is highlighted with a red box and labeled 'ID 7mv'. The 'Enabled Identity Providers' section shows 'Cognito User Pool' selected. The 'Sign in and sign out URLs' section has a text box for 'Callback URL(s)'. The 'OAuth 2.0' section shows 'Allowed OAuth Flows' with 'Authorization code grant' selected, and 'Allowed OAuth Scopes' with 'phone', 'email', 'openid', 'aws.cognito.signin.user.admin', and 'profile' selected.

The next step is to create users that will be allowed to call our CostCalculatorAPI. From the CostCalculatorUserPool, perform the following:

1. Click on **'Users and group'** from the left navigation pane of CostCalulatorUserPool
2. Click **'Create User'**
3. Enter the following values:  
    Username: **testUser**  
    Send an invitation to new user: **Uncheck**  
    Temporary password: **testUser123!**  
    Phone Number: leave blank or enter **+14325551212**  
    Email: *enter your e-mail address*  
    Mark email as verified? **Check**

The screenshot shows the 'Create user' form in the Amazon Cognito console. The form has the following fields and values:  
- Username (Required): testUser  
- Send an invitation to this new user?: ☐  
- Temporary password: testUser123!  
- Phone Number: +14325551212  
- Mark phone number as verified?: ☒  
- Email: (empty field)

4. Click **'Create User'**

Now that the user pool is configured, open up a terminal and use AWS CLI to simulate a login for the user.

1. Enter the following command. Replace the pool id, client id, and username/password attributes:

```
aws cognito-idp admin-initiate-auth --user-pool-id <YOUR POOL ID> --client-id <YOUR CLIENT ID> --auth-flow ADMIN_NO_SRP_AUTH --auth-parameters 'USERNAME=testUser,PASSWORD="testUser123!"'
```

2. The first response to this request should be an authentication challenge, the user pool reminds you that you need to change the password for the user. If you recall, when we created the user it asked us for a temporary password, not the final one

```
{
  "ChallengeName": "NEW_PASSWORD_REQUIRED",
  "ChallengeParameters": {
    "USER_ID_FOR_SRP": "testUser",
    "requiredAttributes": "[]",
    "userAttributes": "{\"email_verified\": \"true\", \"email\": \"userEmail\"}"
  },
  "Session": "...",
}
```

3. Use the CLI to set the final password for the user. Replace the pool ID, client ID, username/pwd and the session attributes. The session value can be retrieved from the response to step 2. Ensure your final passwords contains lower case, upper case, number and character symbols. Session value should include “”

```
aws cognito-idp admin-respond-to-auth-challenge --user-pool-id <YOUR POOL ID> --client-id <YOUR CLIENT ID> --challenge-name NEW_PASSWORD_REQUIRED --challenge-response 'USERNAME=testUser,NEW_PASSWORD=<FINAL PASSWORD>' --session '<SESSION VALUE FROM PREVIOUS RESPONSE>'
```

4. The output from this call should be a valid session

```
{
  "AuthenticationResult": {
    "ExpiresIn": 3600,
    "IdToken": "...",
    "RefreshToken": "...",
    "TokenType": "Bearer",
    "AccessToken": "..."
  },
  "ChallengeParameters": {}
}
```

```
}
```

The response contains three important parameters. The IdToken is the Open ID Connect-compatible identity token that API Gateway uses to authenticate calls - this is the token we will pass to the APIs in the Authorization header. The AccessToken is a JWT token that contains the user scopes and identity pool information. The last property is a refresh token, you can use this token with the User Pool APIs to fetch a new identity and access token.

Note: If needed, you get a new token for a user by using the following AWS CLI command:

```
aws cognito-idp admin-initiate-auth --user-pool-id <YOUR POOL ID> --client-id <YOUR CLIENT ID> --auth-flow ADMIN_NO_SRP_AUTH --auth-parameters 'USERNAME=testUser,PASSWORD=<YOUR NEW PASSWORD>!' "
```

1. Go back to API Gateway Service or go to <https://console.aws.amazon.com/apigateway>
2. Click on 'calculatePrice' API
3. Click 'Authorizers'
4. Click **Create New Authorizer**, then Choose 'Type' as Cognito

**Create Authorizer**

**Name \***

immersion-day-authorizer

**Type \*** ⓘ

☐ Lambda ☒ Cognito

**Cognito User Pool \*** ⓘ

us-east-1

**Token Source \*** ⓘ **Token Validation** ⓘ

|

[Create](#) [Cancel](#)

5. Enter the following values:  
Cognito user Pool: 'CostCalculatorUserPool'  
Token Source: 'Authorization'

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Getting Started with Amazon API Gateway

**Create Authorizer**

**Name \***

immersion-day-authorizer

**Type \* ⓘ**

☐ Lambda ☒ Cognito

**Cognito User Pool \* ⓘ**

us-east-1 CostCalculatorUserPool

**Token Source \* ⓘ** **Token Validation ⓘ**

Authorization

Create Cancel

6. Click **‘Create’**
7. Test your Authorizer by placing the returned **“IdToken”** and click **‘Test’**

immersion-day-authorizer - Test Authorizer

You can test your authorizer by providing values that will be used to invoke your Lambda function or make a call to your Cognito User Pool.

**Authorization Token ⓘ**

Authorization (header) VI3XZaCXuZvouNZK7sYKDhwDStm8JcY3oY4QHFxAH0m90\_PnKB7lwgnlg

Test

**Response**

Response Code: 200

Latency 22

Claims

```
{
  "aud": "7ao0848c7bagukd1ugcp5bgkr8",
  ...
}
```

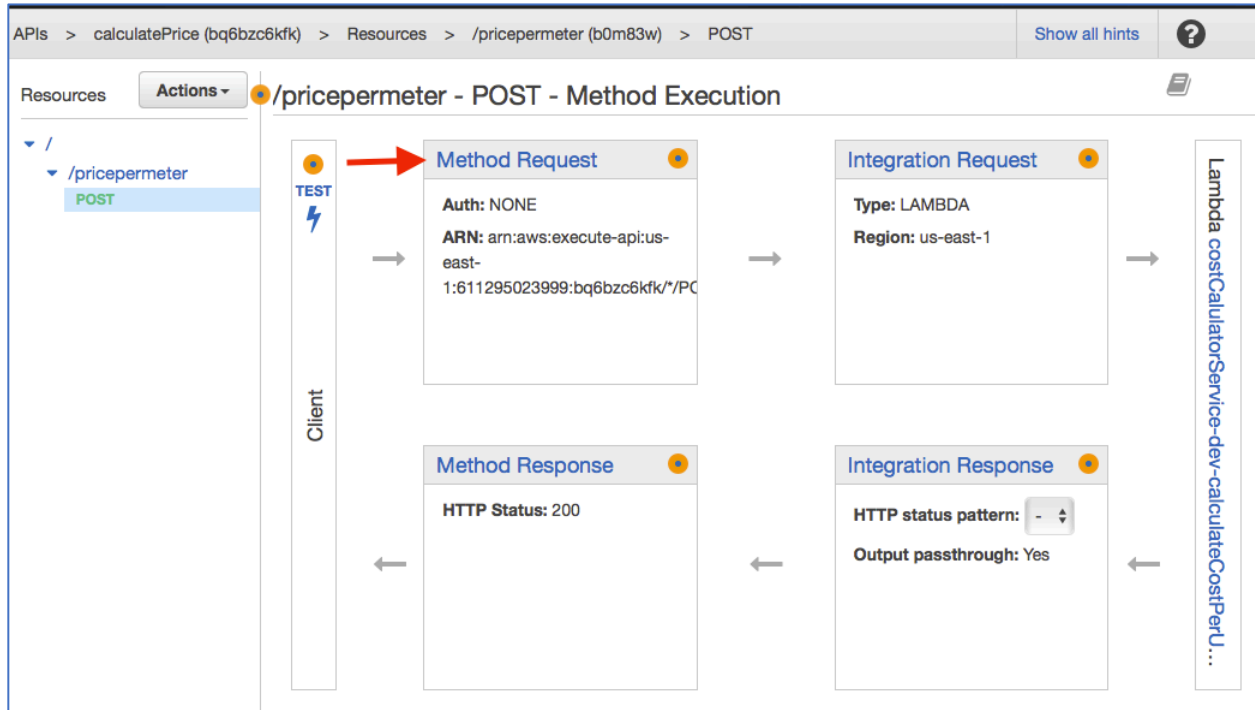
Close

Go back to the **‘calculatePrice’** API and click on the POST action. Set the Method Request Authorization for the API.

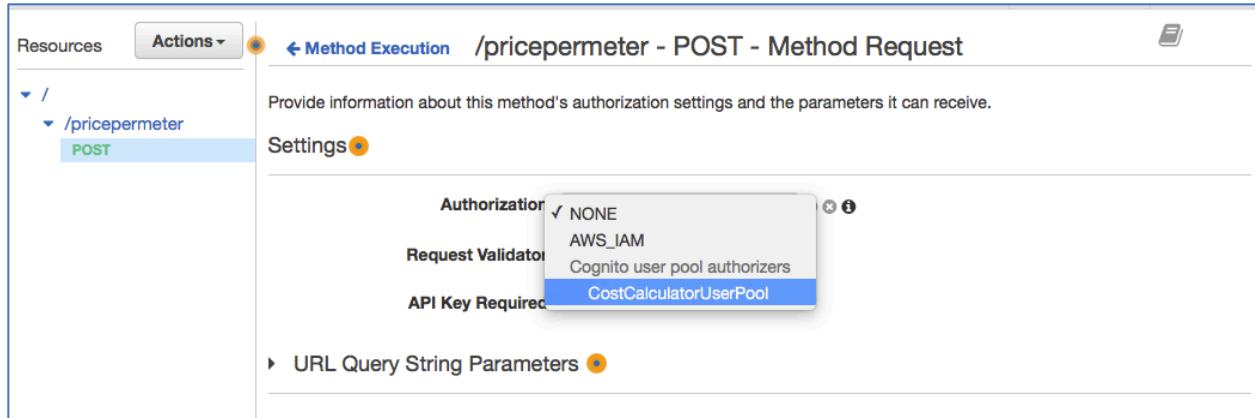
1. From the API Gateway Console, click on **‘Method Request’**



## Serverless Immersion Day Getting Started with Amazon API Gateway



2. Set the Authorization to '**CostCalculatorUserPool**' (may need refresh for the authorizer to be populated in the dropdown)



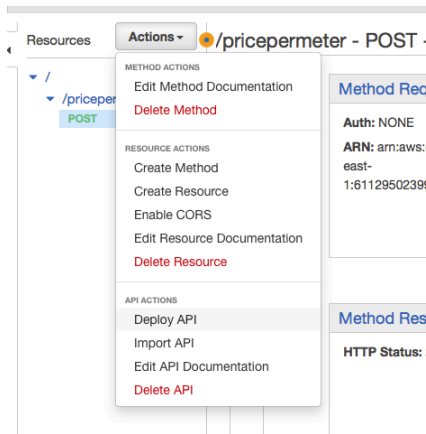
3. Click the '**check**' mark icon to confirm the Authorization.

### API Deployment

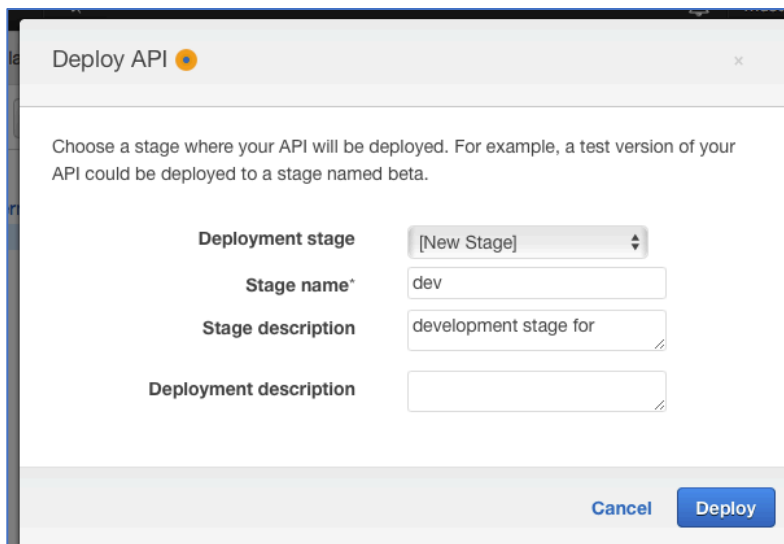
At this point, we have been testing our API using the API Gateway console. Now that we have made the necessary configuration for authorization, we are ready to deploy our API .

1. Select **POST method** from the API Gateway console for the 'calculatePrice' API
2. Select "**Action**" then choose '**Deploy API**'

## Serverless Immersion Day Getting Started with Amazon API Gateway



3. Create a new Stage. Enter the following values:  
Stage Name: dev  
Stage description: development stage for calculate price API  
Deployment

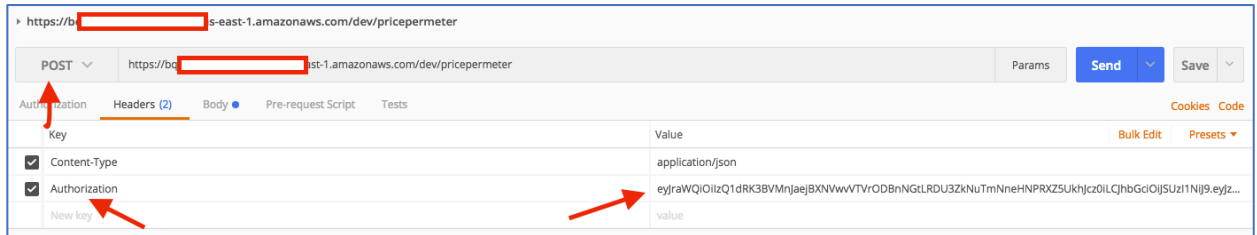


4. Click 'Deploy'
5. Expand the 'dev' stage, and click on the 'POST' method of the priceperimeter.  
**Note the API/Invoke URL. Copy this value as it will be used in the subsequent steps.**

Up to this point, we have used the local API Gateway console to test our API. Now that we have deployed the API, we can test it using external tools. For this lab, we will leverage PostMan to test our API.

1. Insert the service URL into postman

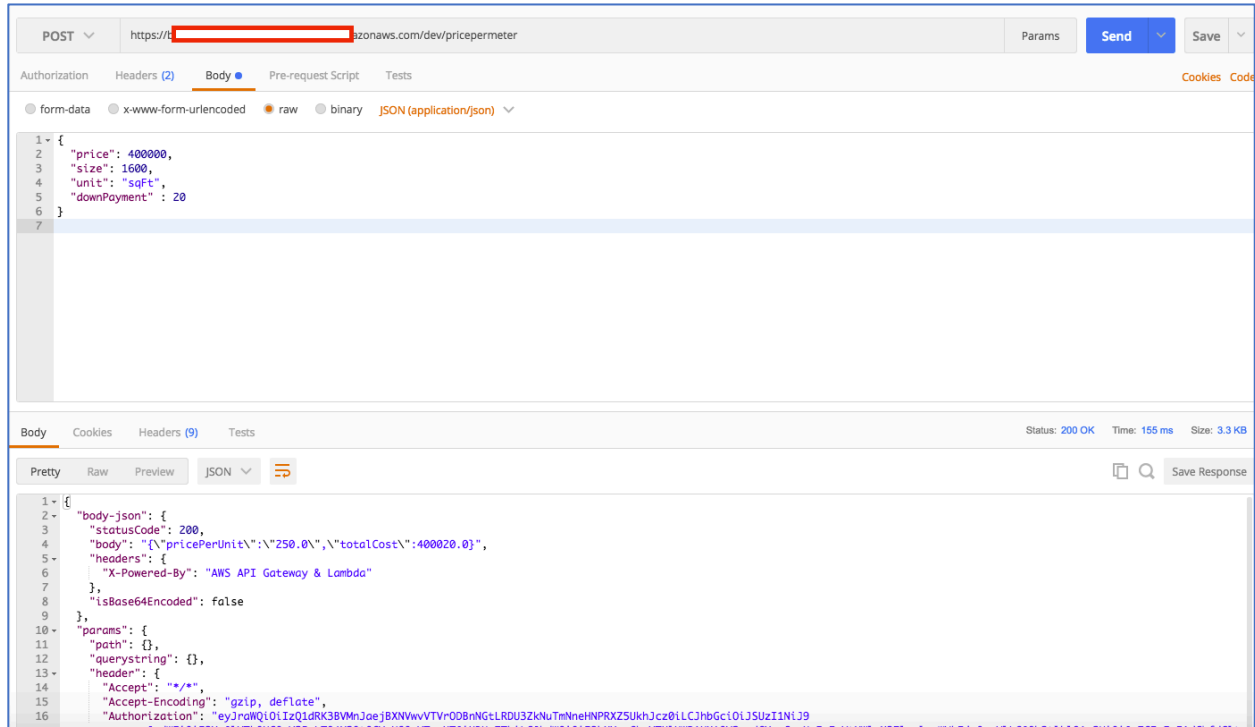
2. Change the method type to POST
3. Click **Headers**. Insert the following attributes  
Key: Authorization  
Value: <Your IdToken>



4. Click **Body**
5. Choose 'raw' type
6. Change Body type to '**JSON (application/json)**'
7. Insert the following request

```
{
  "price": 400000,
  "size": 1600,
  "unit": "sqFt",
  "downPayment" : 20
}
```
8. Click '**Send**'

## Serverless Immersion Day Getting Started with Amazon API Gateway



Congratulations, you have just deployed your first API !

### Lab 1 Summary

In lab 1, you created your first API using AWS API Gateway. In this lab, you configured API Gateway to call a lambda service, transformed and validated the request message, and secured the API. In the next lab, you will learn additional features of API Gateway.

## Lab 2: Additional API Gateway Features

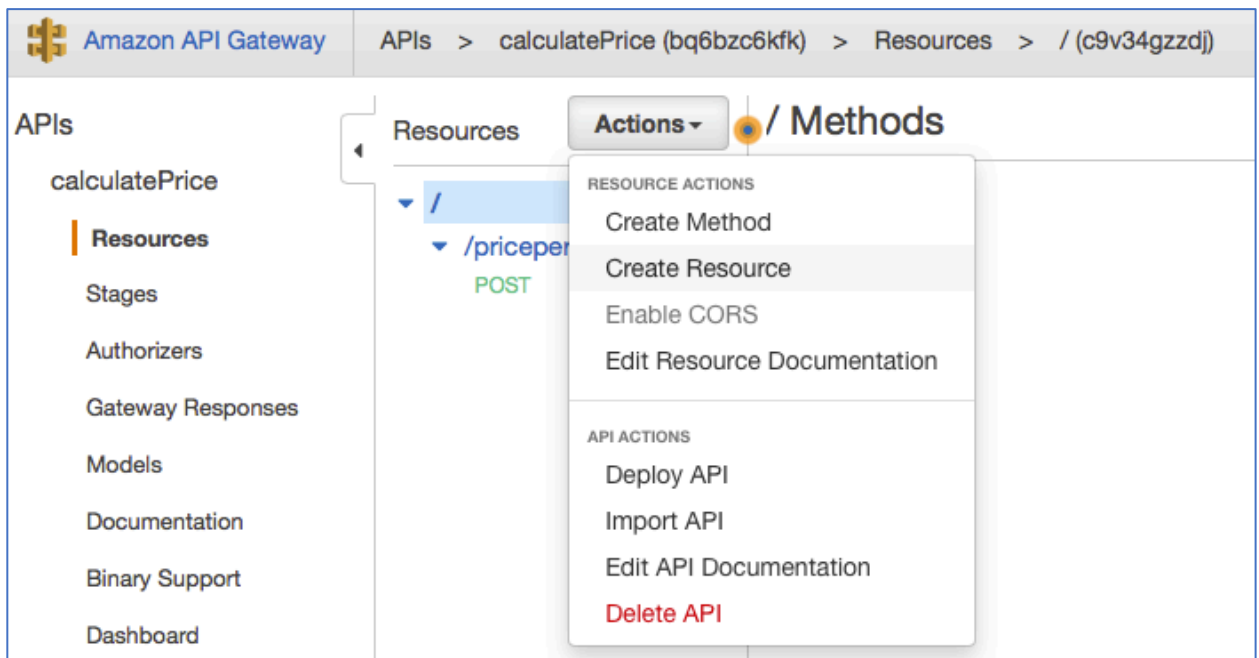
In the second part of the lab, we will create a new API and configure the API to perform message caching and throttling. In addition, we will configure usage plans for our platinum, silver and gold customers.

### Message Caching

You can enable API caching in Amazon API Gateway to cache your endpoint's response. With caching, you can reduce the number of calls made to your endpoint and also improve the latency of the requests to your API. When you enable caching for a stage, API Gateway caches responses from your endpoint for a specified time-to-live (TTL) period, in seconds. API Gateway then responds to the request by looking up the endpoint response from the cache instead of making a request to your endpoint.

API Gateway enables caching at the stage or method level. In this lab, we will create a new resource called 'medianPriceCalculator'. This service returns the median price of houses in US or Canada. Since these regional prices do not change often, we can cache the results.

1. From API Gateway Console, select the root element of **CalculatePrice** API
2. Click **Actions**, then choose '**Create Resource**'



3. Enter the following values  
Resource Name: '**medianPriceCalculator**'  
Resource Path: '**medianPriceCalculator**'
4. Click '**Create Resource**'

5. Click on **Actions**, then Choose **'Create Method'**.
6. Choose **'POST'** and select **check mark**.
7. For the Post Setup, choose the following values:  
Integration Type: **Lambda Function**  
Lambda Region: **us-east-1 (or your chosen region)**  
Lambda Function: **serverless-immersion-day-sta-MedianPriceCalculator-XX**

The screenshot shows the 'POST - Setup' configuration page in the Amazon API Gateway console. On the left, a sidebar shows the resource hierarchy: '/' > '/medianpricecalculator' (POST) > '/pricepermeter' (POST). The main area is titled '/medianpricecalculator - POST - Setup' and contains the following configuration options:

- Integration type:** Radio buttons for 'Lambda Function' (selected), 'HTTP', 'Mock', and 'AWS Service'.
- Use Lambda Proxy integration:** A checkbox that is currently unchecked.
- Lambda Region:** A dropdown menu showing 'us-east-1'.
- Lambda Function:** A text input field containing 'f'. Below it, a dropdown menu shows two options: 'serverless-immersion-day-stac-CalculateCostPerUnit-TRBKGWNB5HM' and 'serverless-immersion-day-sta-MedianPriceCalculator-2RHLHYX40LCR'.
- Save:** A blue button in the bottom right corner.

8. Click **'Save'**, then **'Ok'**.

Now that the API is created, we can enable caching at the method level. Since the median price for Canada and US are different, it would make sense to cache based on the chosen region. When a cached method or integration has parameters, which can take the form of custom headers, URL paths, or query strings, you can use some or all of the parameters to form cache keys. API Gateway can cache the method's responses, depending on the parameter values used.

In this example, we will create a query parameter to cache the results based on the region attribute. The 'region' can take a value of 'US' or 'CA', United States or Canada respectively.

1. Click the **'POST'** method of the medianpriceCalculator API.
2. From the API Console, click on **'Method Request'**
3. Expand the **'URL Query String Parameters'**.
4. Click **'Add query String'**
5. Enter **'region'** for the name
6. Click on **'Check'** icon
7. Check **'Caching'**

## Serverless Immersion Day Getting Started with Amazon API Gateway

Provide information about this method's authorization settings and the parameters it can receive.

**Settings**

Authorization: NONE ⓘ

Request Validator: NONE ⓘ

API Key Required: false ⓘ

URL Query String Parameters ⓘ

Name	Required	Caching
region	<input type="checkbox"/>	<input checked="" type="checkbox"/>

[Add query string](#)

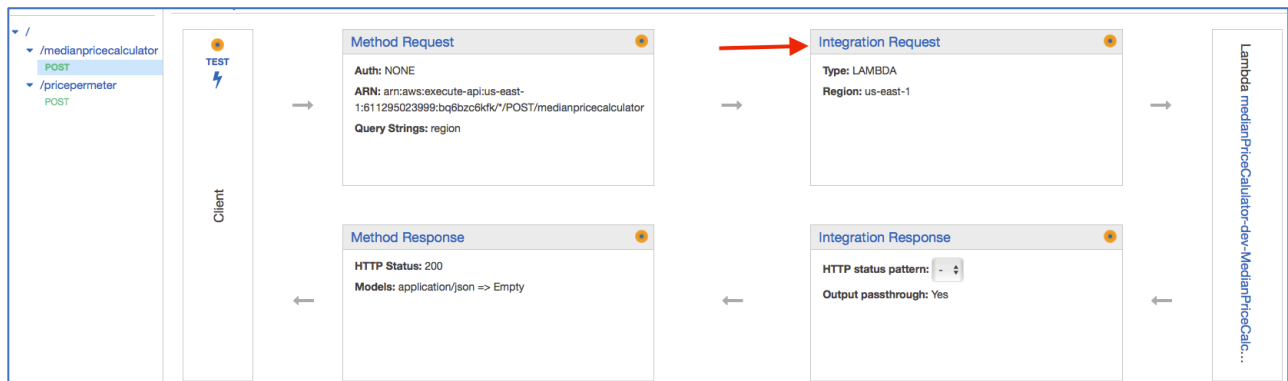
HTTP Request Headers

Request Body ⓘ

SDK Settings

Now that we are passing the 'region' as a query parameter, we need to map it to the integration payload.

1. Click on '**medianpricecalculator**' and then click on '**POST**' action.
2. Click on '**Integration Request**' from the API Console



3. Expand '**Mapping Templates**'
4. Click on '**When there are no templates defined (recommended)**'
5. Click '**Add mapping template**'
6. Enter '**application/json**' for content-Type
7. Click on **Check mark**

▼ Body Mapping Templates

**Request body passthrough**

☐ When no template matches the request Content-Type header ⓘ

☒ When there are no templates defined (recommended) ⓘ

☐ Never ⓘ

Content-Type
application/json

+ Add mapping template

8. Click on 'application/json' content type.
9. Enter the following mapping for the 'application/json' template

```
{
  "region" : "$input.params('region')"
```

▼ Body Mapping Templates

**Request body passthrough**

☐ When no template matches the request Content-Type header ⓘ

☒ When there are no templates defined (recommended) ⓘ

☐ Never ⓘ

Content-Type
application/json

+ Add mapping template

application/json

Generate template:

```
1 {
2   "region" : "$input.params('region')"
```

10. Click 'Save'



At this point, we are essentially taking the 'region' value from the query parameter and mapping it into the request.

Now, its time to deploy our new API.

1. Click on '**POST**' method of '**medianpricecalculator**'
2. Click on **Actions**
3. Click on '**Deploy API**'
4. Choose '**dev**' stage
5. Enter optional description
6. Click '**Deploy**'

Now that the method is deployed, we can go ahead and enable caching.

1. Click '**Stages**' under the 'CalcualtePrice' API
2. Click on the '**dev**' stage
3. Check '**Enable API Cache**'
4. Choose Cache capacity: **0.5 GB**
5. Enter Cache time-to-live (TTL): **60**
6. Uncheck '**Require Authorization**' for Per-key cache invalidation and uncheck '**Enable Throttling**'.

The screenshot shows the 'Cache Settings' tab for the 'dev' stage of the 'medianpricecalculator' API. The 'Enable API cache' checkbox is checked. A yellow banner below it states: 'Enabling API cache increases cost and is not covered by the free tier. See pricing for more details'. The 'Cache capacity' is set to 0.5GB, 'Cache time-to-live (TTL)' is 60, and 'Require authorization' is unchecked. The 'Save Changes' button is at the bottom right.

7. Click Save Changes

**Note:** When you enable caching for a stage, only GET methods have caching enabled by default. This helps to ensure the safety and availability of your API. You can enable caching for other methods by overriding method settings. This overriding should also be done for GET methods that you want to specifically disable caching

Notice that the Cache Status is 'CREATE\_IN\_PROGRESS'. Once the cache state changes to 'Available', caching will be enabled.

Since we created "POST" method for *medianpricecalculator* resource, it is required to override the *dev* stage settings in *medianpricecalculator*.

1. From the 'dev' stage, click on '*medianpricecalculator*'
2. Click on the 'POST' method
3. Select '**Override for the method**'
4. **Check** the Enable Method Cache.

Use this page to override the [dev stage](#) settings for the POST to /medianpricecalculator method.

**Settings** ☐ Inherit from stage  
☒ Override for this method

---

**CloudWatch Settings**

Enable CloudWatch Logs ☐ ⓘ

Enable Detailed CloudWatch Metrics ☐ ⓘ

---

**Method Throttling**

Choose the throttling level for this method. Your current account level throttling rate is **10000** requests per second with a burst of **5000** requests. ⓘ

Enable throttling ☐ ⓘ

---

**Cache Settings**

Configure the cache for POST to /medianpricecalculator

Enable Method Cache ☒

Encrypt cache data ☐

Cache time-to-live (TTL)

**Per-key cache invalidation**

Require authorization ☐

[Save Changes](#)

5. Click '**Save Changes**'

Go back to the *medianpricecalculator* POST method from the 'dev' stage and Copy the Invoke URL.

## Serverless Immersion Day Getting Started with Amazon API Gateway



### Testing Your Cached Resource

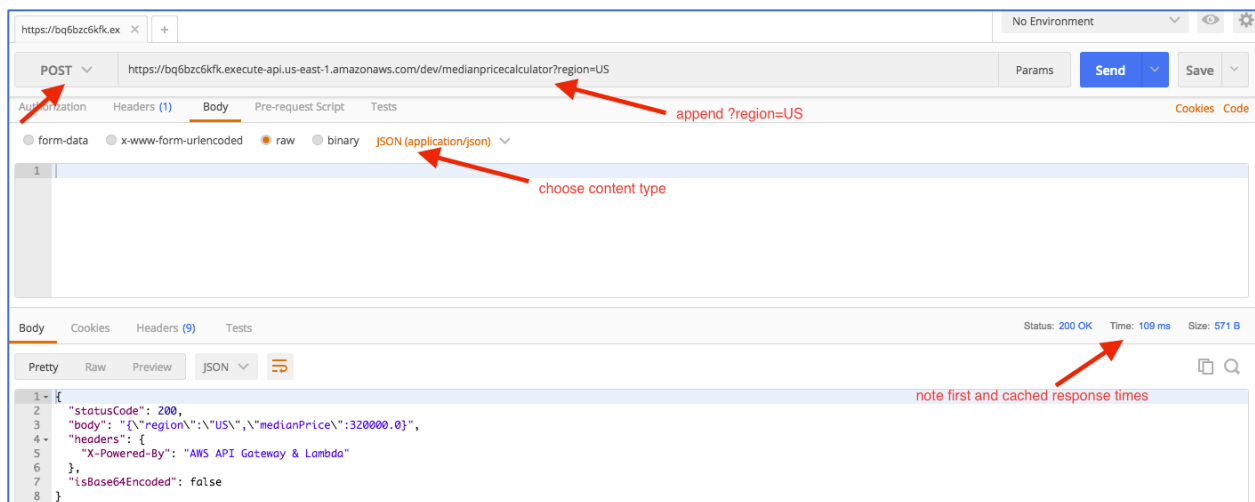
Now that we have created our second API, it is time to test it. Notice that the medianPriceCalculator service gives the median house price for two US regions (US and Canada). Since we are caching based on the 'region' parameter, the responses from '?region = US' will be cached separately from the response from '?region=CA'.

Go ahead and create a new API using POST Man.

1. Enter the copied URL and append **?region=US** at the end of the URL  
Example:

**http://....i.us-east-1.amazonaws.com/dev/medianpricecalculator?region=US**

2. Change Method type to '**POST**'
3. Click on '**Body**' and choose '**Raw**'
4. Set Content-Type to '**JSON (application/json)**'



5. Click '**Send**'

Notice the Response time for the first invocation. Go ahead and invoke the method several more times. You will notice that the subsequent invocation response time is much faster.

You can change the region to 'CA' to get the response for Canada region. You will notice that the first invocation takes slightly longer than subsequent invocations.

(OPTIONAL) We have set the cache to expire after 60 seconds. You can also manually flush the cache from the API Gateway console and observe the cached response times after the flush.

## Usage Plans and Message Throttling

To prevent your API from being overwhelmed by too many requests, Amazon API Gateway throttles requests to your API. There are pre-defined steady-state and burst throttling limits set at the account level. As an API owner, you can set the default method throttling to override the account-level request throttling limits for a specific stage or for individual methods in an API. In addition, you can setup usage plans to restrict client request submissions to within specified request rates and quotas.

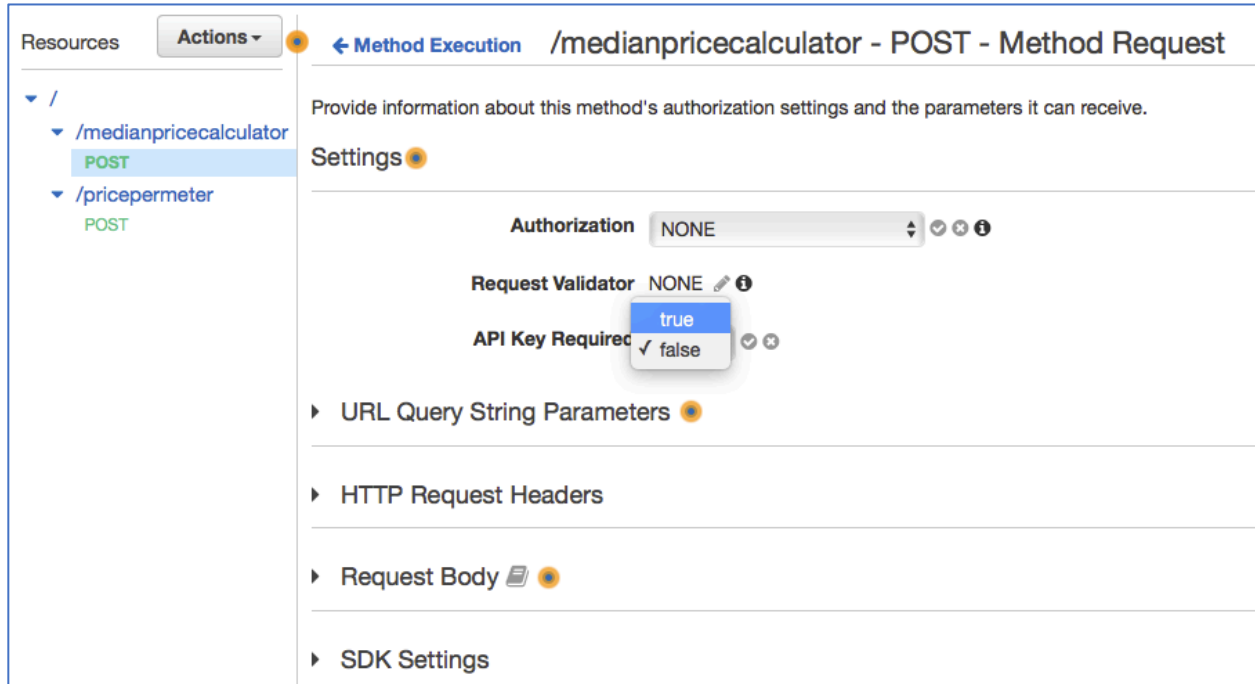
A usage plan provides access to one or more deployed API stages with configurable throttling and quota limits enforced on individual client API keys. API callers are identified by API keys that can be generated by API Gateway. The throttling prescribes the request rate limits applied to each API key.

In the subsequent sections of the lab, we are going to setup API Keys to track our API Callers. The API keys will then be used to setup usage plans and restrict each client based on their tier level (platinum, gold, silver, etc).

## Setting up API Keys

1. If not already done, Sign in to the AWS Management Console and open the API Gateway console at <https://console.aws.amazon.com/apigateway/>.
2. In the API Gateway main navigation pane, choose **POST** action of medianpricecalculator.
3. Select **Method Request**
4. Under the **Settings** section, choose **true** for **API Key Required**.
5. Select the **check-mark** icon to save the settings.

Serverless Immersion Day  
Getting Started with Amazon API Gateway

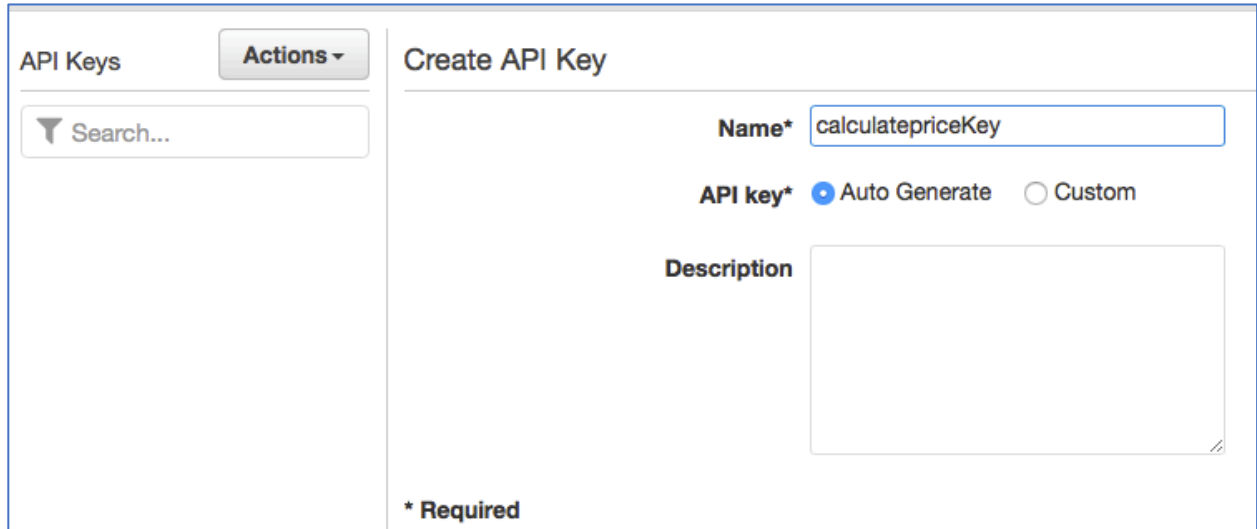


6. Deploy or redeploy the API for the requirement to take effect. (Choose Actions → Deploy API). Deploy to the **dev** stage.

Now that our API requires an API key, we have to create one.

1. In the API Gateway main navigation pane, choose **API Keys**.
2. From the **Actions** drop-down menu, choose **Create API key**.
3. Enter following values:

Name: 'calculatepriceKey'  
API Key: Autogenerate



The screenshot shows the 'Create API Key' form in the Amazon API Gateway console. On the left, there is a sidebar with 'API Keys' and a search bar. The main area is titled 'Create API Key'. It contains three fields: 'Name\*' with the value 'calculatepriceKey', 'API key\*' with radio buttons for 'Auto Generate' (selected) and 'Custom', and 'Description' which is an empty text area. A red asterisk and the text '\* Required' are at the bottom left of the form.

4. Click **Save**

#### Setting Up Usage Plans

Once the API keys are created, the next step is to create a Usage plan.

1. In the Amazon API Gateway main navigation pane, choose **Usage Plans**,
2. Click **Create** to create a new usage plan.
3. Under **Create Usage Plan**, enter the following:

For **Name**, type '**Platinum**'

For **Description**, type a description for your plan.

Select **Enable throttling** and set **Rate** to **100** and **Burst** to **200**

Choose **Enable quota** and set its **limit** to **5000** for a selected time interval **Month**.

## Create Usage Plan

Usage Plans help you meter API usage. With Usage Plans, you can enforce a throttling and quota limit available to each key. Quota limits define the number of requests each API key is allowed to make over

**Name\***

**Description**

### Throttling

**Enable throttling** ☒ ⓘ

**Rate\***  requests per second ⓘ

**Burst\***  requests ⓘ

### Quota

**Enable quota** ☒ ⓘ

requests per  ⓘ

**\* Required**

4. Choose **Next**.
5. Click **'Add API Stage'**
6. Choose **'CalculatePrice'** API
7. Choose **'dev'** stage
8. Select the **check box** to confirm

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Getting Started with Amazon API Gateway

Associated API Stages

Associate API stages to this usage plan. Subscribers will only be allowed to access the API stages that are associated with the plan. Choose "Add API Stage" below, then use the dropdown to select an API and stage to enable for this usage plan.

Add API Stage

API	Stage
calculatePrice	dev

Back Next

9. Click 'Next'
10. Click 'Add API Key to Usage Plan'
11. Type 'calculatepriceKey' (type and wait for population)

Usage Plan API Keys

Subscribe an API key to this usage plan. Choose "Add API Key" below to search through key and apply the plan's throttling and quota limits.

Add API Key to Usage Plan Create API Key and add to Usage Plan

Name

Enter API key name

calculatepriceKey (egcrf...)

12. Click 'check mark' to confirm
13. Click Done

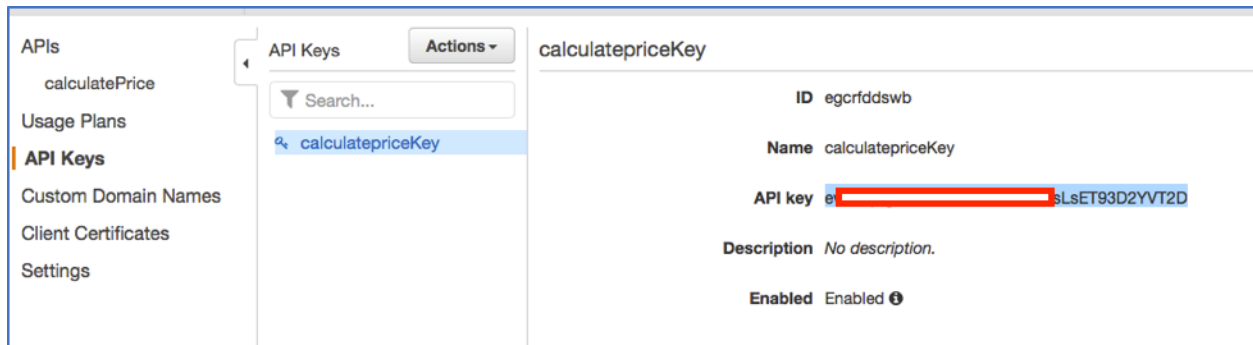
At this point, we have created a 'platinum' usage plan that enables the calculate price API to accept 100 requests and burst up to 200 requests. If desired, we can also create "silver" and "bronze" plans that enable fewer requests.



## Testing API with Usage Plan

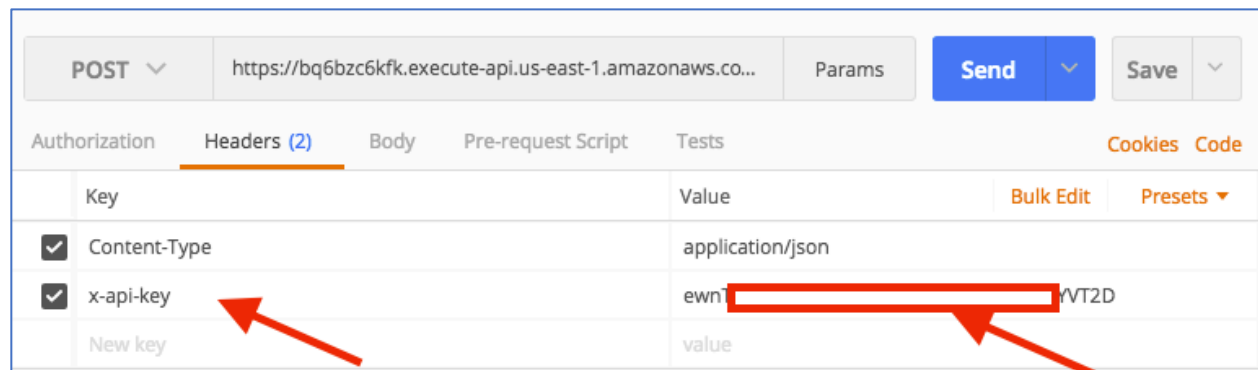
Once the Keys are created and associated with an API, they are typically distributed to developers or customers. In this lab, we will use POSTMAN to test our deployed service with the API Keys.

1. In the Amazon API Gateway main navigation pane, choose **API Keys**
2. Select '**calculatepriceKey**'
3. Click '**Show**' to reveal the **API Key**
4. Copy the API Key in a notepad



Using Postman, configure the following

1. Select the 'medianpricecalculator' in POSTMAN
2. Set the Header attribute 'x-api-key'
3. Set the value with your API KEY
4. Click **Send**

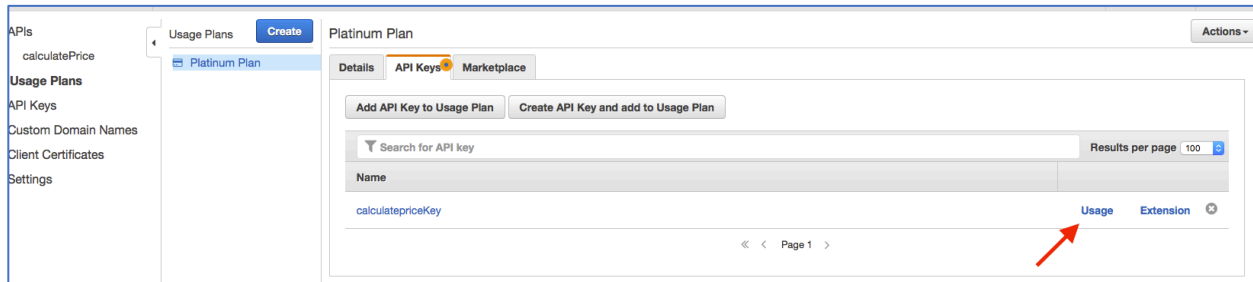


Invoke the method several times and then go to usage plan to see the number of invocations remaining.

1. In the Amazon API Gateway main navigation pane, choose **Usage Plans**
2. Click on '**Platinum Plan**'

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3. Click on 'API Keys'
4. Click 'Usage'



5. Notice the usage **statistics**. **Please note that usage data can be delayed.**
6. Click on **Extension**
7. You can observe the number of requests that are still available.

Verify that API key is used by sending POST request without x-api-key. On Postman

1. On "Headers", uncheck "x-api-key" key
  2. Hit Send. You should see below message
- ```
{
  "message": "Forbidden"
}
```

## Lab 2 Summary

In the second part of this lab, you were able to successfully enable caching for your API. You learned how to cache data at the stage level, and method level. In particular, you were able to create an API and cache the data based on the parameter query. In addition to caching, you were also able to setup API Keys and associate those keys with a usage plan. The usage plan restricted the throttling limit of your API.

## Clean up

- 1) Go to Cognito > Manage User Pools
  - a) Select **CostCalculatorUserPool**
  - b) Click “Delete pool” button on the top right
- 2) Go to CloudFormation
  - a) Select “serverless-immersion-day-stack”
  - b) On Actions, select “Delete stack”. Hit “Yes, Delete”
- 3) Go to Amazon API Gateway
  - a) Select “calculatePrice” API
  - b) On Actions, select “Delete API”. Type the API name and hit “Delete API” button

## Appendix

### Deploying Lambda Functions

1. Download the Serverless Application Model (SAM) template (package-template.yaml).  
<https://s3.amazonaws.com/serverless-immersion-api-gateway/package-template.yaml>  
package-template.yaml (Save and check the file name is package-template.yaml)
2. If not already done, install AWS CLI - Follow the [AWS CLI Getting Started](#) guide to install and configure the CLI on your machine
3. If not already done, run the following command to configure your AWS CLI (please note that the region should be set to us-east-1)

```
$ aws configure
AWS Access Key ID [None]: <Enter Access Key ID>
AWS Secret Access Key [None]: <Enter Secret key>
Default region name [None]: us-east-1
Default output format [None]: json
```

4. Run the following command to deploy the lambda functions

```
aws cloudformation deploy --template-file path-to-template-file/package-template.yaml --stack-name serverless-immersion-day-stack --capabilities CAPABILITY_IAM
```

The above command deploys two lambda functions. Below is a description of each function and the applicable lab sections.

| Function Name         | Description                                                                                                                                                    | Lab Usage |
|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| CostCalculator        | Lambda function that calculates the price per unit and the total cost of a house.<br><br>Price per unit = price/size<br>Total cost = downpaymentAmount + price | Lab 1     |
| MedianPriceCalculator | Lambda function that returns the median price of a house in US (\$320,000) and Canada (240,000).                                                               | Lab 2     |

Once the above command is executed, you can verify the deployment of these functions by going to the lambda console.

5. Go to the Lambda console at <https://console.aws.amazon.com/lambda>
6. Verify that **serverless-immersion-day-api-CalculateCostPerUnit-XX** and **serverless-immersion-day-api-MedianPriceCalculator-XX** are listed.

## Serverless Immersion Day Getting Started with Amazon API Gateway

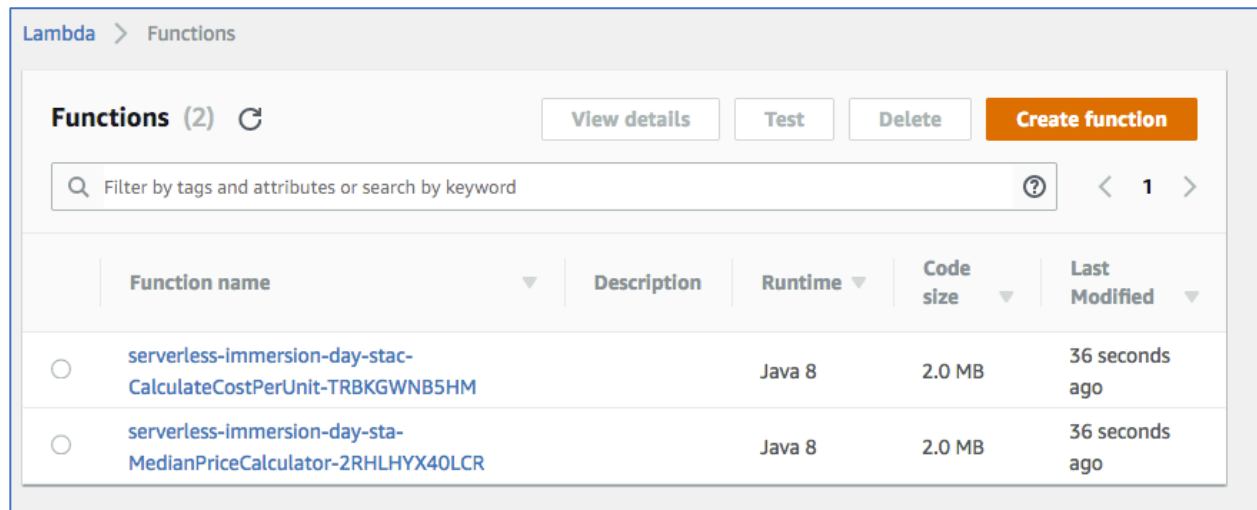


Figure 21: Lambda functions

**You are now ready to start the lab !!**