Indian Institute of Technology Delhi

Cloud Computing

ELL887

Assignment 3 - Costing

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Entry No: **2023EET2187**

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In this assignment, we evaluate the cost of the architecture created in Assignment 2 across three major public cloud providers: Azure, AWS, and GCP. The Total Cost of Ownership (TCO) calculator helps us identify scenarios where cloud migration is either beneficial or not.

Architecture Components

The architecture from Assignment 2 is comprised of:

- Azure App Services
- Azure Server
- Azure SQL Database

Question-1

Compare the price of the architecture you created in Assignment 2 for the 3 public clouds. (Make some realistic assumptions if required). Submit screenshots of the pricing tools you have used.

Solution-

Cloud 1-Azure

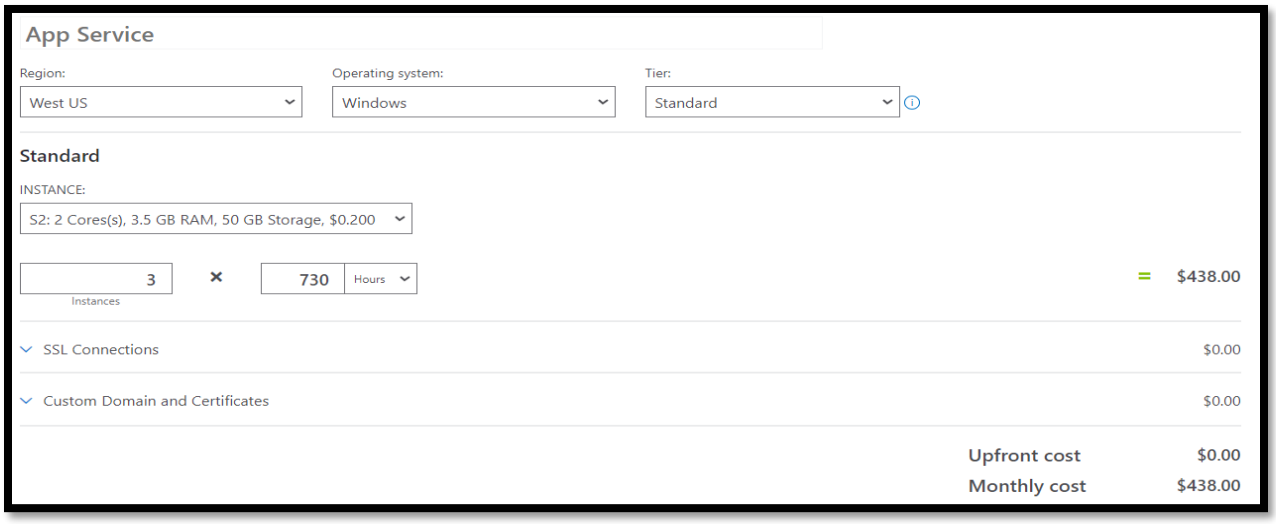
Assumptions:

- ***App Service***: The service uses Windows OS and the Standard tier, which supports three instances of S2 with moderate specifications (2 cores, 3.5 GB RAM, 50 GB storage).
- ***Azure SQL Database***: The single database setup uses a general-purpose, provisioned tier in the standard series with one instance of 2 vCore and locally redundant storage.
- ***Load Balancing***: The standard tier load balancing service handles up to three rules and 42 GB of data processed in a month.

1)App Service

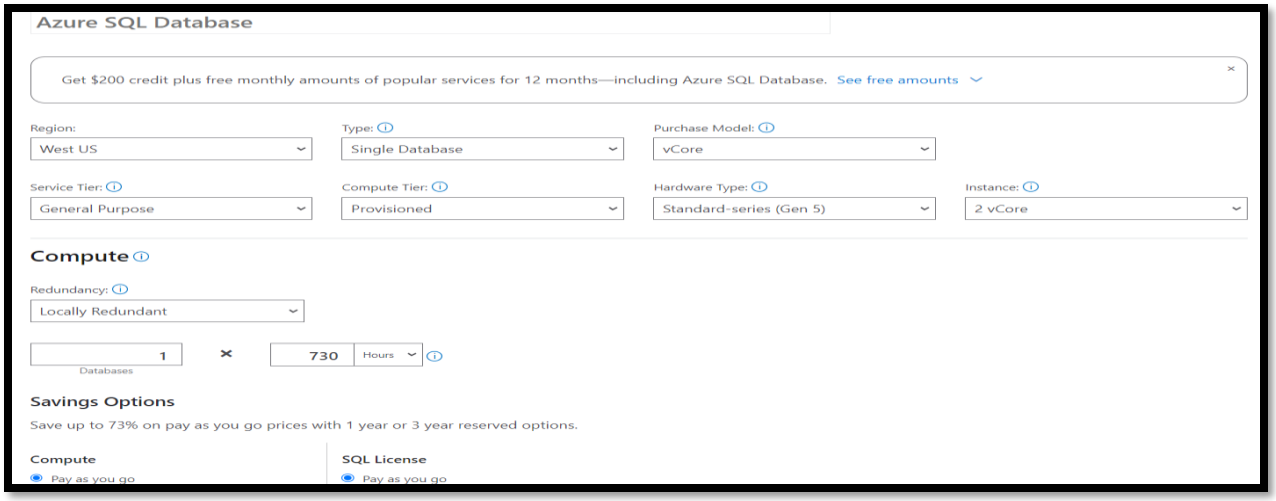
- **Region**: West US
- **Operating System**: Windows
- **Tier**: Standard
- **Instance**:
    - **3 S2 instances**: Each instance has 2 cores, 3.5 GB RAM, and 50 GB storage.
    - **Usage**: The usage is based on 730 hours per instance.

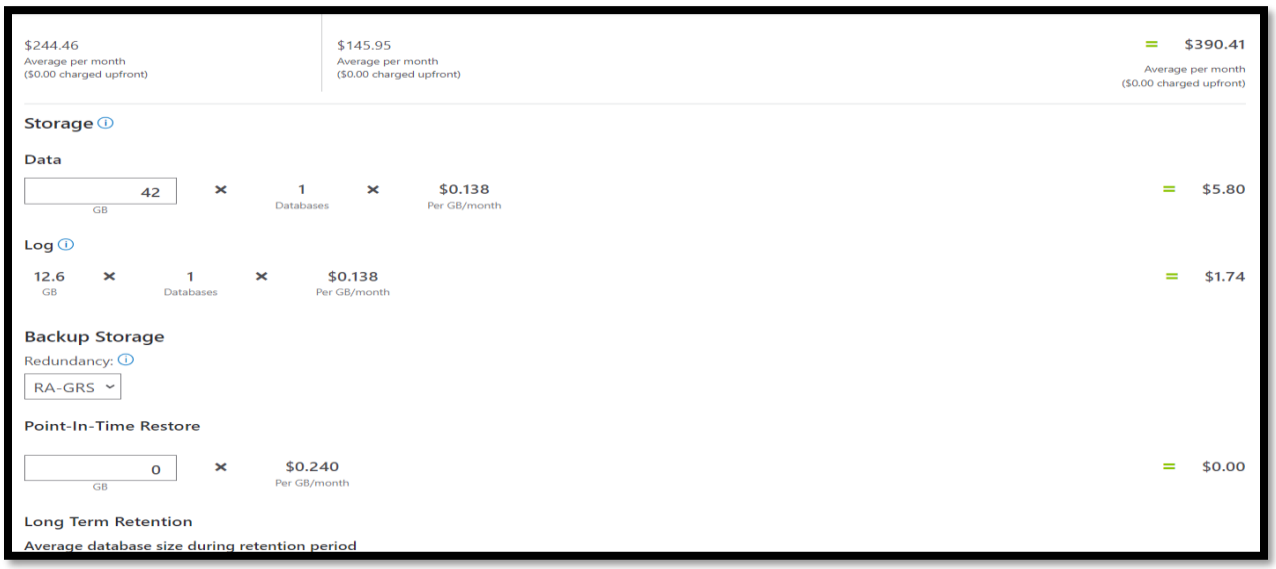
- **Monthly Cost**: $438.00.

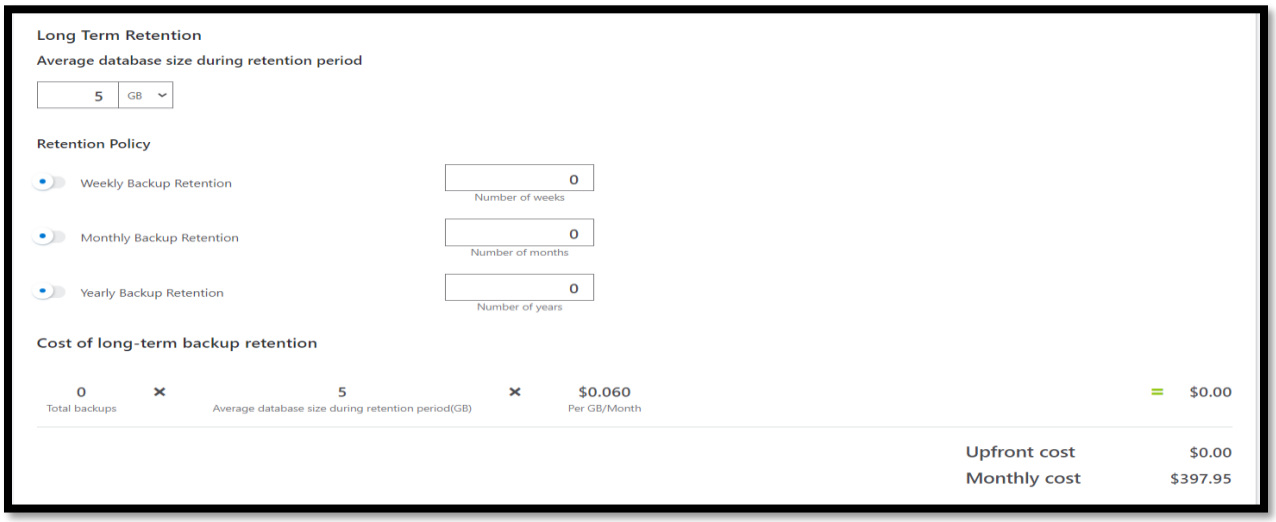


2)Azure SQL Database

- **Region**: West US
- **Type**: Single Database
- **Purchase Model**: vCore
- **Service Tier**: General Purpose
- **Compute Tier**: Provisioned using Standard-series (Gen 5) hardware.
- **Instance**:
    - **1 database with 2 vCores** and locally redundant configuration.
    - **Usage**: 730 hours.
- **Storage**: 42 GB storage and 12.6 GB log.
- **Monthly Cost**: $397.95.

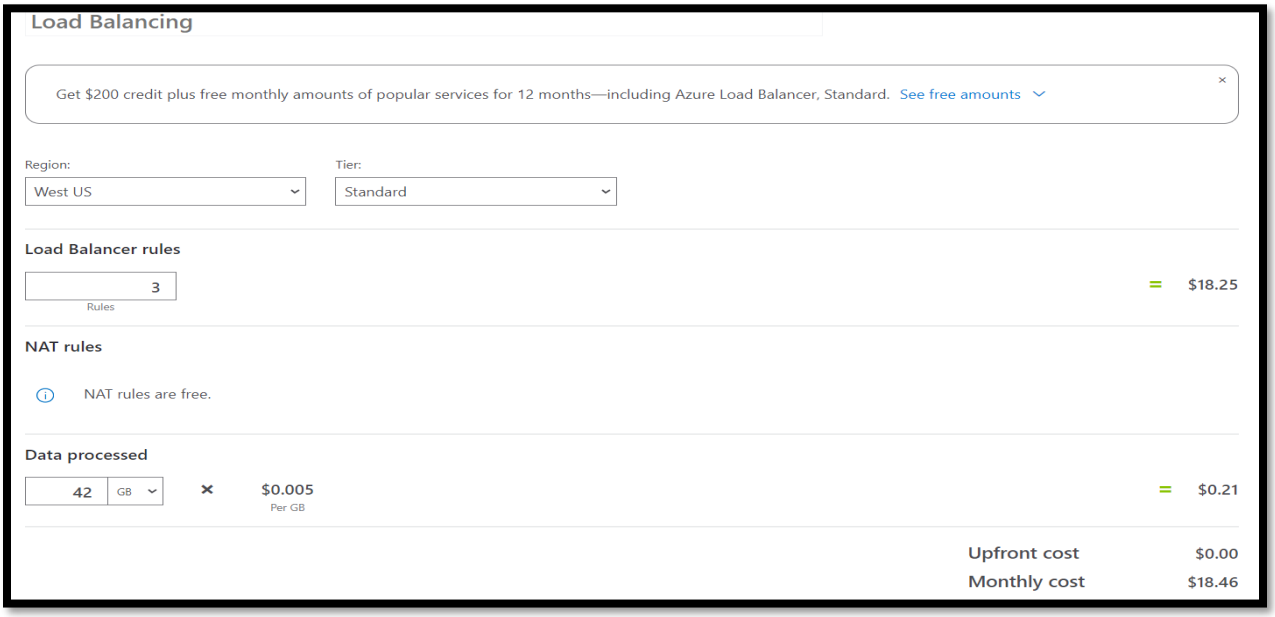

Azure SQL Database
Get $200 credit plus free monthly amounts of popular services for 12 months—including Azure SQL Database. See free amounts
Region: West US
Type: Single Database
Purchase Model: vCore
Service Tier: General Purpose
Compute Tier: Provisioned
Hardware Type: Standard-series (Gen 5)
Instance: 2 vCore
Compute
Redundancy: Locally Redundant
1 Databases × 730 Hours
Savings Options
Save up to 73% on pay as you go prices with 1 year or 3 year reserved options.
Compute
Pay as you go
SQL License
Pay as you go


$244.46
Average per month
($0.00 charged upfront)
$145.95
Average per month
($0.00 charged upfront)
= $390.41
Average per month
($0.00 charged upfront)
Storage
Data
42 GB × 1 Databases × $0.138 Per GB/month = $5.80
Log
12.6 GB × 1 Databases × $0.138 Per GB/month = $1.74
Backup Storage
Redundancy: RA-GRS
Point-In-Time Restore
0 GB × $0.240 Per GB/month = $0.00
Long Term Retention
Average database size during retention period


Long Term Retention
Average database size during retention period
5 GB
Retention Policy
Weekly Backup Retention
0 Number of weeks
Monthly Backup Retention
0 Number of months
Yearly Backup Retention
0 Number of years
Cost of long-term backup retention
0 Total backups × 5 Average database size during retention period(GB) × $0.060 Per GB/Month = $0.00
Upfront cost $0.00
Monthly cost $397.95

3)Load Balancing

- **Region**: West US
- **Tier**: Standard
- **Configuration**:
    - **3 rules** and 42 GB data processed.
    - **NAT rules** are free.
- **Monthly Cost**: $18.46.

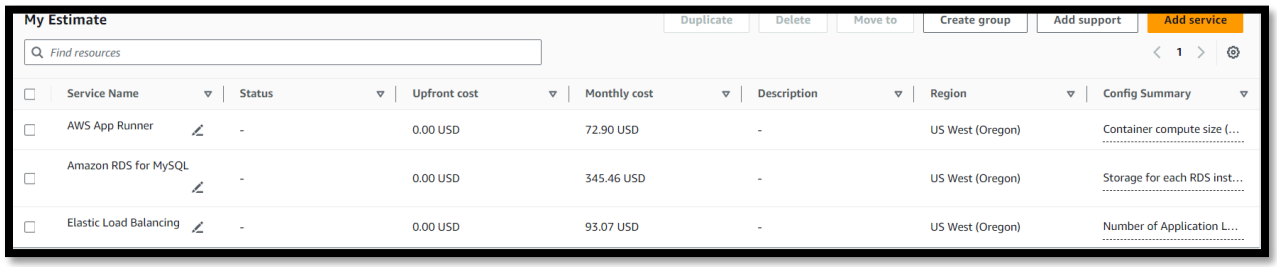


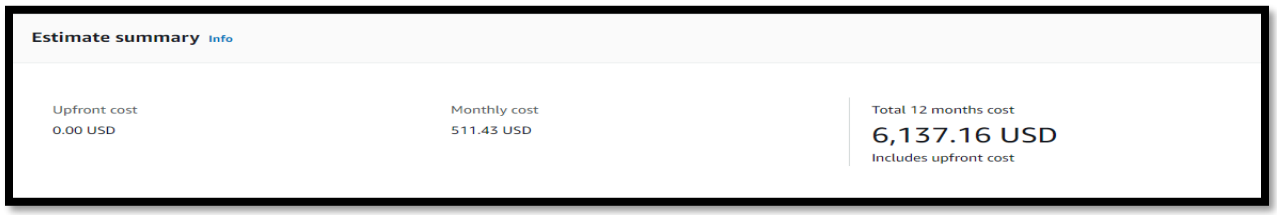
Summary:

- **App Service**: The monthly cost is **$438.00**.
- **Azure SQL Database**: The monthly cost is **$397.95**.
- **Load Balancing**: The monthly cost is **$18.46**.

Total Monthly Cost: **$854.41**

Cloud-2 AWS





Assumptions:

App Service-

Requires 1 vCPU and 2 GB memory per instance.Supports up to 400 requests simultaneously.Auto-scales with at least 3 instances. 4 hours of peak traffic at 300 requests/second; 20 hours of off-peak traffic at 100 requests/second. Based on compute, provisioned memory, and vCPU usage.

Database:

db.m1.large with 2 vCPUs and 7.5 GiB memory, in multi-AZ deployment.Monthly cost based on on-demand pricing, hourly instance rate, and 42 GB General Purpose SSD storage costs.

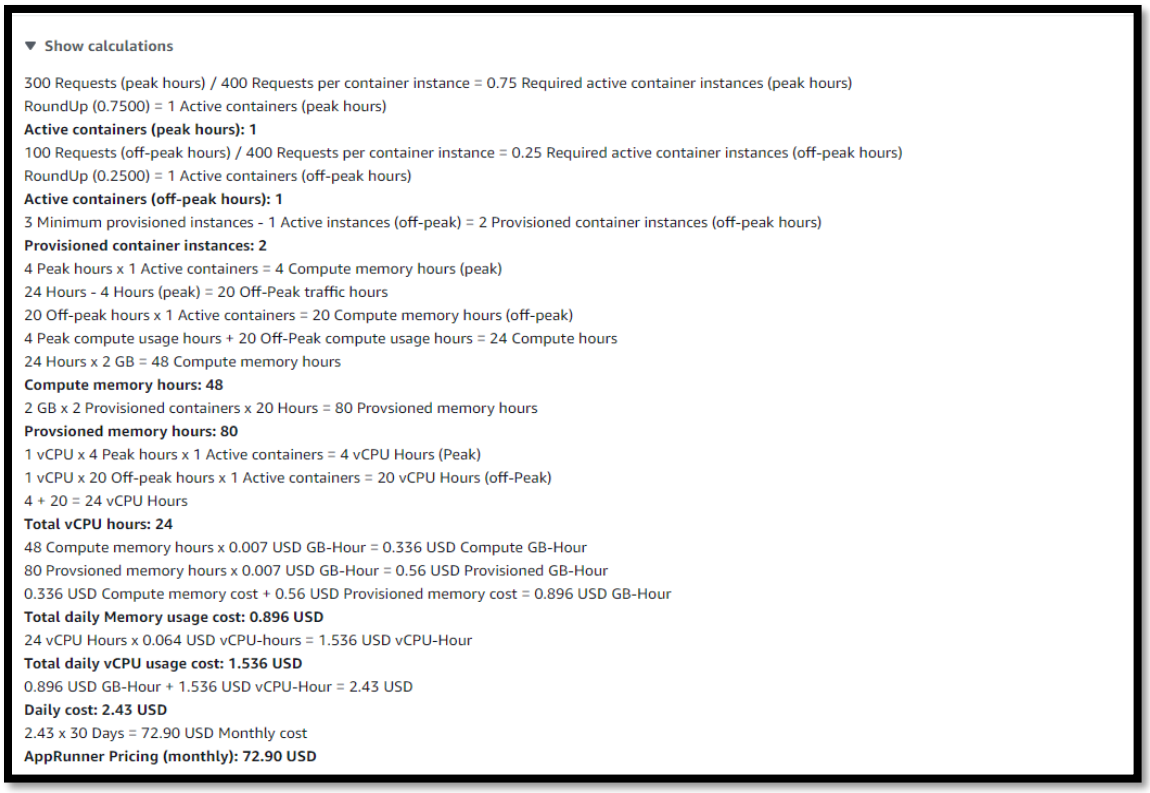
Load Balancer:

Monthly cost for 3 ALBs at $0.0225 per hour each, totaling $49.27.Pricing based on processed bytes for Lambda targets, average new connections, connection duration, and requests per second per ALB.

1)App Runner:

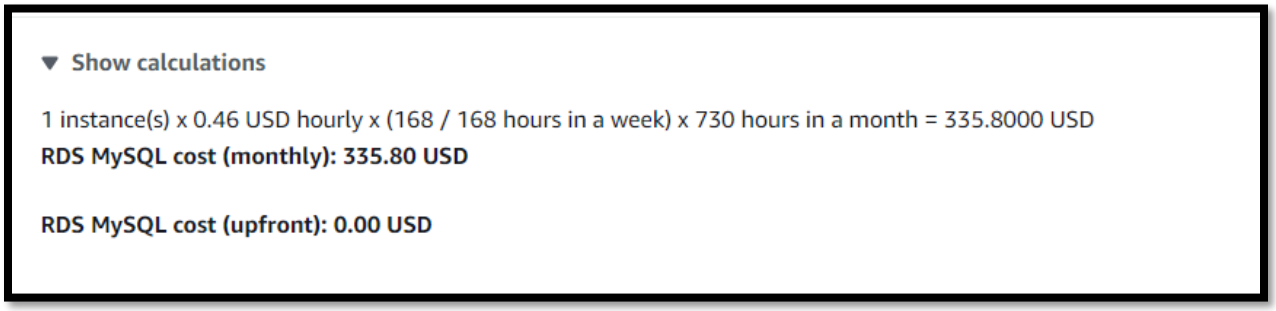
- **Container Settings**: 1 vCPU, 2 GB memory.
- **Auto Scaling**: Adjusts container instances based on demand.
- **Concurrency**: Max 400 simultaneous requests per container.
- **Provisioned Containers**: Minimum of 3 instances, regardless of traffic.
- **Peak/Off-Peak Hours**: 4 peak hours, 20 off-peak hours.

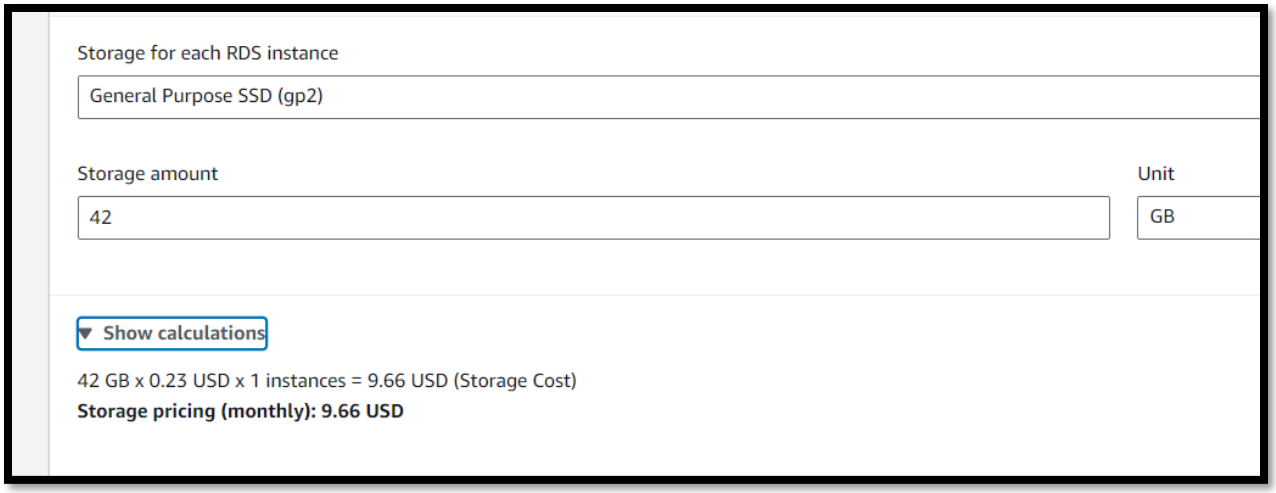
- **Total Cost**-$72.90



2)MySQL Instance:

- **Specifications**: 1 instance (db.m1.large), 2 vCPUs, 7.5 GiB memory.
- **Deployment**: Multi-AZ for redundancy.
- **Pricing**: On-Demand model.
- **Storage**: 42 GB General Purpose SSD.
- **Total Cost**- $345.46



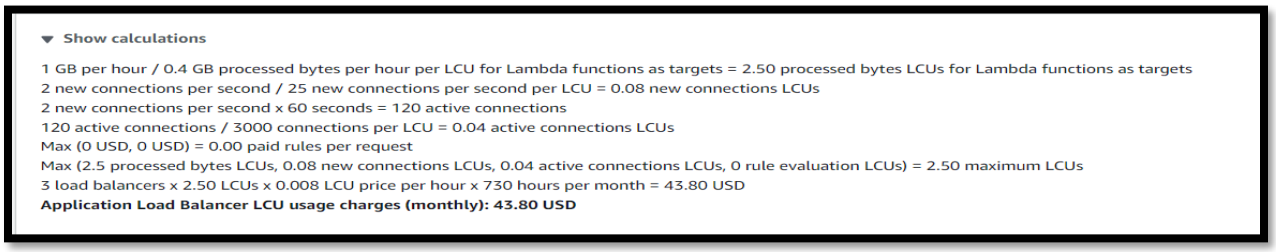


3)Load Balancer:

- **Number**: 3 Application Load Balancers.
- **Processed Bytes**: 1 GB/hour, with Lambda functions as targets.
- **Connections**: 2 new connections per second per ALB, 60-second duration.
- **Requests**: 3 requests per connection.
- **Pricing**: Based on Load Balancer Capacity Units and usage hours.
- **Total Cost**- $93.07

Service settings

Load Balancer Capacity Units (LCUs)



Cloud-3 GCP (Google Cloud Platform)

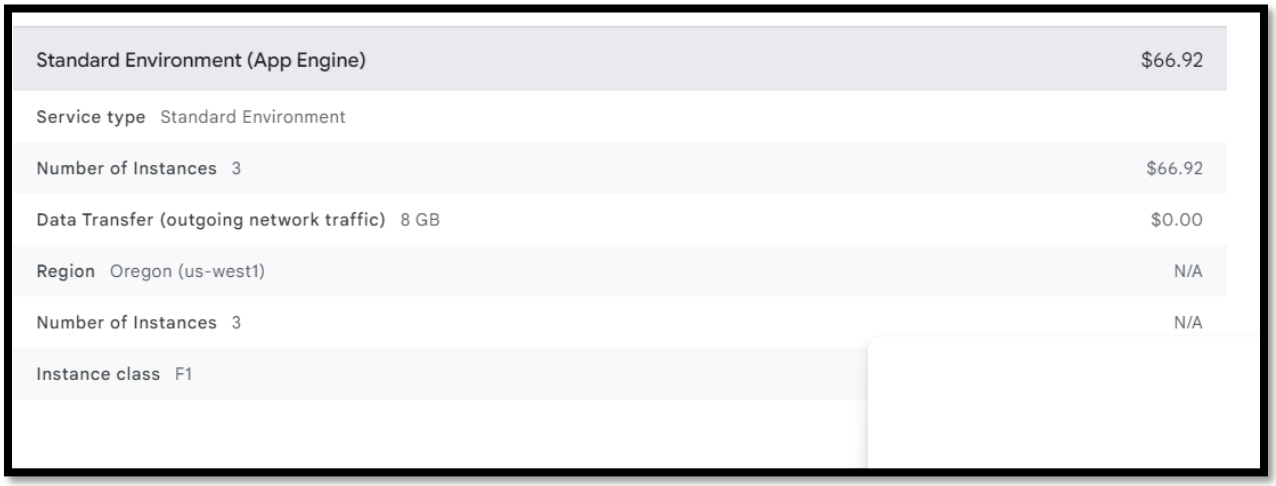
Assumptions:

App Service: The 3 instances are appropriately scaled to handle the traffic and workload.

Database- It provide the required specifications for the workload, ensuring resilience and minimal downtime with high availability. Storage and cache usage meet performance needs, while data transfer stays within free tier limits.

1). App Service

- **Standard Environment (App Engine)**:
  - **Cost**: $66.92 per month.
  - **Service Type**: Standard Environment with 3 instances.
  - **Data Transfer**: 8 GB of outgoing network traffic at no extra cost.
  - **Region**: Oregon (us-west1).
  - **Instance Class**: F1 (standard).
  - **Total Cost**- $66.92



2)MySQL (Cloud SQL):

- **Cost**: $1,508.04 per month.
- **Service Type**: MySQL in Cloud SQL.
- **Instance-Time**: Utilizes 2,190 hours.
- **Storage**: 42 GB Provisioned SSD storage.
- **Data Cache**: Enabled with an additional cost of $360.
- **Region**: Oregon (us-west1).
- **SQL Edition**: Enterprise Plus.
- **Number of Instances**: 3 instances of db-perf-optimized-n-2 (2 vCPUs, 16 GB RAM) with high availability.
- **Total Cost**- $1508.04

DATABASES	$1,508.04
MySQL (Cloud SQL)	$1,508.04
Service type MySQL	
Instance-time 2190 Hours	$1,108.14
Storage (Provisioned Amount) 42 GB	N/A
Instance-time 2190 Hours	$39.90
Enable Data Cache true	$360.00
Region Oregon (us-west1)	N/A
Cloud SQL Edition Enterprise Plus	N/A
Number of Instances 3	N/A
Select SQL instance type db-perf-optimized-n-2, vCPUs: 2, RAM: 16 GB	N/A
Enable High Availability Configuration true	N/A
Storage Type SSD	N/A
Committed use discount options None	N/A
SERVERLESS	$66.92

Comparison price architecture between all clouds-

1. Azure

- **App Service**: $438.00
- **Azure SQL Database**: $397.95
- **Load Balancing**: $18.46
- **Total: $854.41**

2. AWS

- **App Runner**: $72.90
- **MySQL (RDS)**: $335.80
- **Application Load Balancer**: $43.80
- **Total**: **$452.50**

3. GCP

- **Databases (MySQL Cloud SQL)**: $1,508.04
- **Serverless (App Engine)**: $66.92
- **Total**: **$1,574.96**

Analysis-

- **AWS** has the lowest overall monthly cost at **$452.50**, followed by **Azure** at **$854.41**.
- **GCP** has a higher overall monthly cost at **$1,574.96**, primarily due to the higher cost of MySQL Cloud SQL services.
- AWS provides the most cost-effective solution in this comparison, while GCP is the most expensive.
- Azure falls in between AWS and GCP in terms of total cost.

In summary, AWS is the most economical choice based on the monthly cost of similar services. Azure and GCP offer slightly higher costs, with GCP being the most expensive option.

Question-2

Utilize the Total Cost of Ownership Calculator to determine a scenario where moving to cloud is advisable and a scenario where it is not advisable.

Solution-

Scenario-1

Growing E-Commerce Startup

A growing e-commerce startup is looking to optimize its IT infrastructure to handle seasonal fluctuations in demand while keeping costs low. The startup wants to focus on its core business activities rather than spending time and resources on maintaining on-premises hardware and IT support. By moving to the cloud, the startup can take advantage of several key benefits.

By taking advantage of cloud computing, the e-commerce startup can optimize its costs, improve scalability and flexibility, and focus more on its core business operations. This strategic move positions the startup for continued growth and success in a competitive market.

Assumptions:

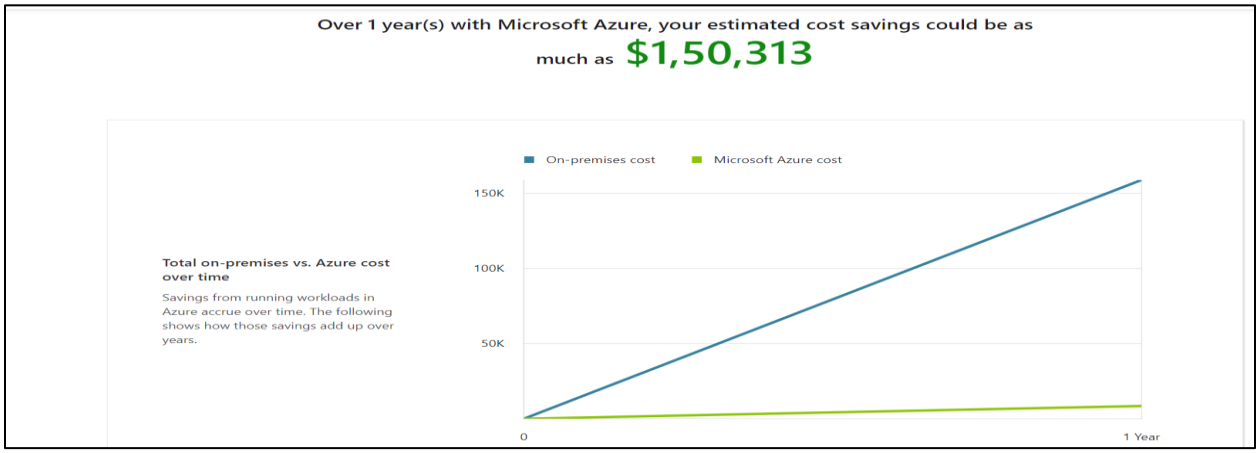
1. **Elasticity and Cost Optimization**:
    - During peak shopping seasons, such as holidays, the startup experiences a significant increase in web traffic and sales. By using cloud services, the startup can quickly scale its infrastructure to accommodate the increased demand and only pay for the additional resources it uses.
    - After the peak season ends, the startup can scale back down, reducing costs associated with idle resources.
2. **Cost Savings**:
    - Instead of investing in expensive on-premises hardware and data center infrastructure, the startup can shift its expenses to a pay-as-you-go model with cloud services.
    - This allows the startup to allocate its capital towards other strategic investments, such as marketing or product development.
3. **Reduced IT Maintenance**:
    - By moving to the cloud, the startup reduces its reliance on on-premises hardware and data center maintenance. The cloud provider handles infrastructure management, freeing up the startup's IT team to focus on enhancing the customer experience and developing new features.

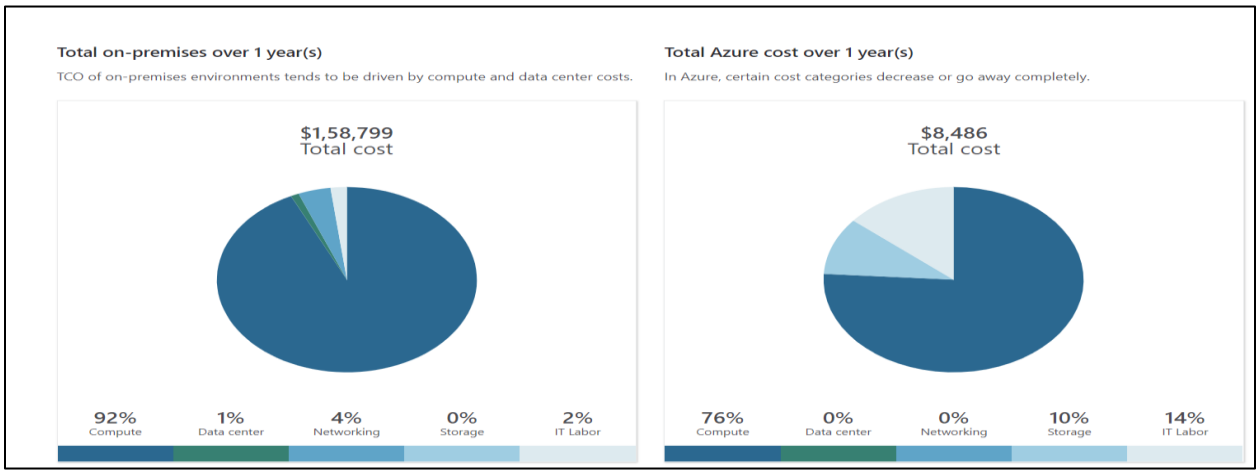
4. **Automated Updates and Maintenance**:
    - Cloud providers take care of routine updates and maintenance for hardware, software, and security patches. This ensures that the startup's systems are up-to-date and secure without requiring significant intervention from the internal IT team.
5. **Easier Maintenance of Remote Workforces**:
    - The startup has remote employees across different locations. By using cloud-based solutions, the startup can provide easy access to systems and data from anywhere, facilitating collaboration and enhancing productivity among remote teams.

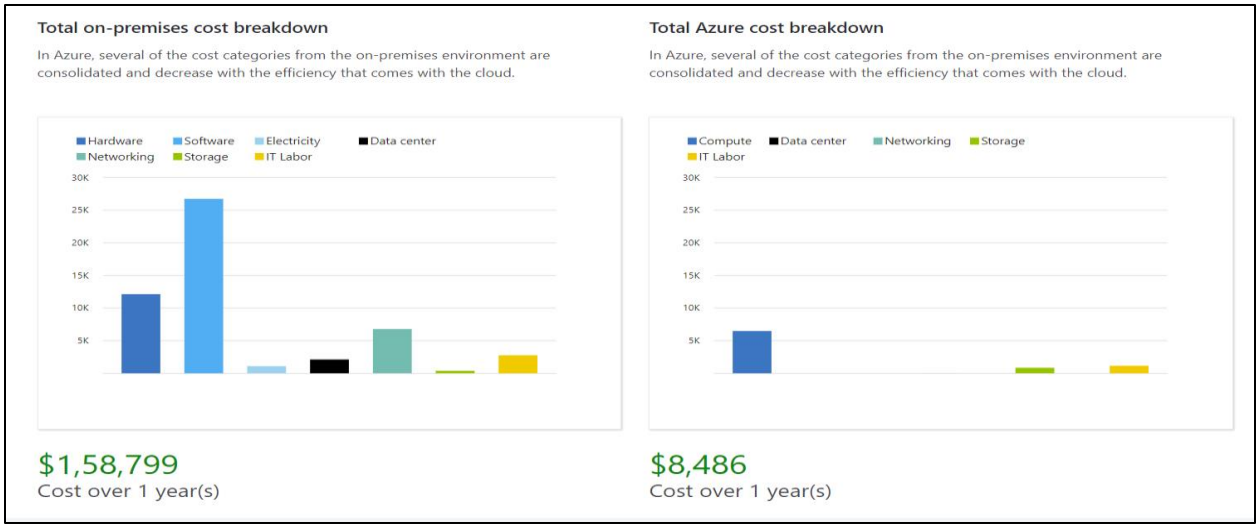
Graphs-

On-Premises Environment: Total: $158,799.00

Proposed Migration to Azure: Total: $8,486.00







On-premises cost breakdown summary

Category	Cost
Compute	$1,46,756.73
Hardware	$12,124.80
Software	$26,726.25
Electricity	$1,093.68
Database	$1,06,812.00
Data Center	$2,115.89
Networking	$6,781.01
Storage	$385.28
IT Labor	$2,760.00
Total	$1,58,799.00

Azure cost breakdown summary

Category	Cost
Compute	$6,481.80
Data Center	$0.00
Networking	$9.36
Storage	$845.12
IT Labor	$1,150.00
Total	$8,486.00

Scenario-2

Automotive Manufacturing Company

An automotive manufacturing company manages large-scale production lines that require custom hardware configurations, specialized equipment, and certain devices not easily replicated in the cloud. The company relies on these custom systems to ensure efficient and high-quality production of vehicles.

In this scenario, the automotive manufacturing company benefits from the stability and control offered by on-premises infrastructure, which aligns with its need for custom hardware configurations, existing infrastructure investments, and predictable workloads. Moving to the cloud

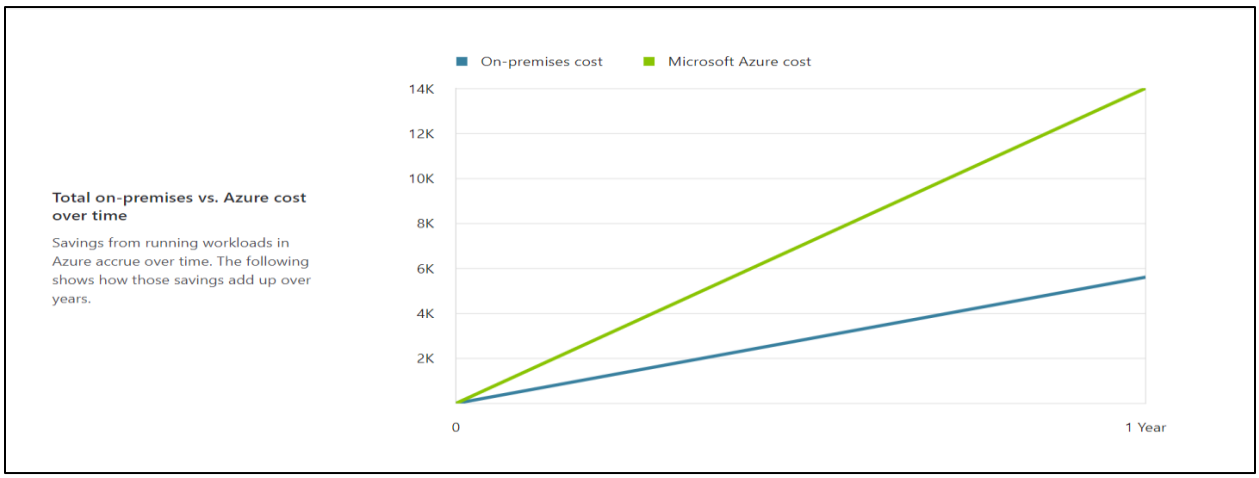
may introduce higher costs, particularly in data transfer, and disrupt established manufacturing processes.

Assumptions:

1. **Custom Hardware Requirements:** The production lines rely on custom hardware and specialized devices, such as robotics, sensors, and machine vision systems. Replicating these in the cloud would be challenging and potentially less efficient.
2. **Existing Infrastructure Investment:** The company has made significant investments in on-premises hardware, including custom-built machines and manufacturing systems. It may be more economical to continue utilizing these existing resources rather than transitioning to the cloud.
3. **High Data Transfer Costs:** The company frequently transfers large amounts of data from its production lines to its data centers for analysis and quality control. If moved to the cloud, data egress charges could accumulate and increase operational costs.
4. **Complex Legacy Systems:** The company's manufacturing processes are supported by complex legacy systems deeply integrated into its existing infrastructure. Transitioning these systems to the cloud could be disruptive and costly.
5. **Predictable Workloads with Consistent Usage:** The manufacturing processes follow predictable patterns with consistent usage and demand. Maintaining on-premises infrastructure for such workloads may be more cost-effective than utilizing cloud solutions, which are better suited for variable and unpredictable workloads.

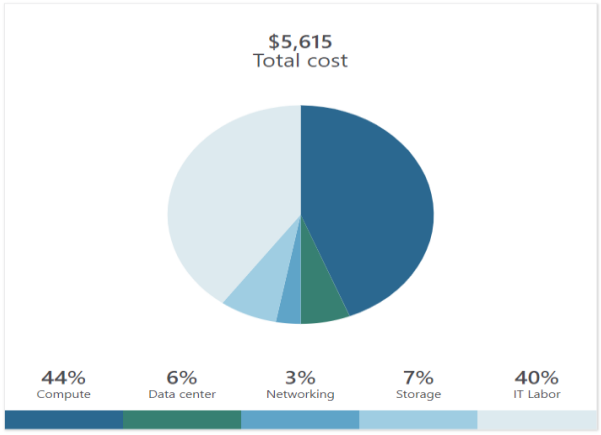
Graphs-

- **Total On-Premises Cost: $5,615 over** 1 year
- **Total Azure Cost: $14,021** over 1 year



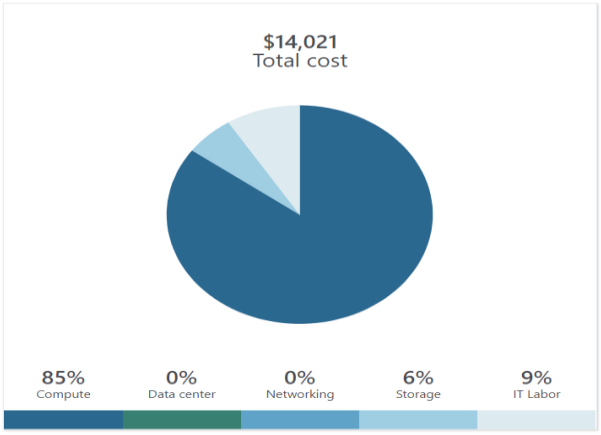
Total on-premises over 1 year(s)

TCO of on-premises environments tends to be driven by compute and data center costs.



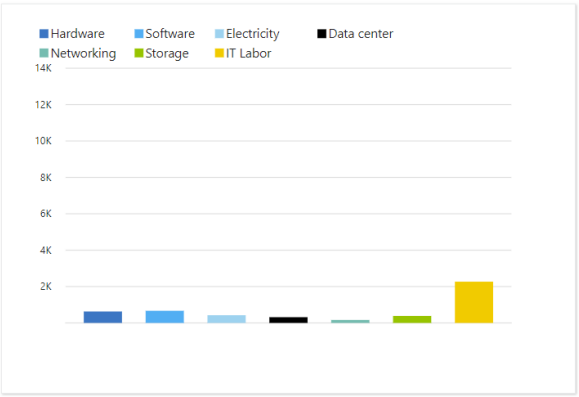
Total Azure cost over 1 year(s)

In Azure, certain cost categories decrease or go away completely.



Total on-premises cost breakdown

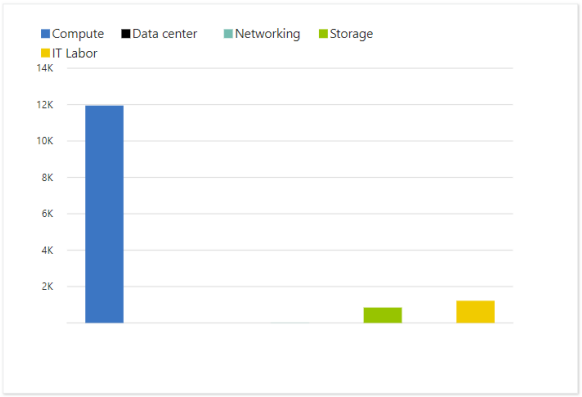
In Azure, several of the cost categories from the on-premises environment are consolidated and decrease with the efficiency that comes with the cloud.



$5,615
Cost over 1 year(s)

Total Azure cost breakdown

In Azure, several of the cost categories from the on-premises environment are consolidated and decrease with the efficiency that comes with the cloud.



$14,021
Cost over 1 year(s)

On-premises cost breakdown summary

Category	Cost
Compute	$2,479.56
Hardware	$629.88
Software	$668.16
Electricity	$425.52
Database	$756.00
Data Center	$316.19
Networking	$164.95
Storage	$385.28
IT Labor	$2,268.76
Total	**$5,615.00**

Azure cost breakdown summary

Category	Cost
Compute	$11,946.24
Data Center	$0.00
Networking	$9.36
Storage	$845.12
IT Labor	$1,220.5165
Total	**$14,021.00**