Anomaly Detection in Host Log Files

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Research Question

Anomaly Detection in Host Log Files

Can we detect suspicious user activity hidden in massive computer log files?

Unified Network & Network Data Set

"A subset of network and computer (host) events collected from the Los Alamos National Laboratory enterprise network over the course of approximately 90 days."[1]

Details

- Microsoft Windows Computers
- Logs Deidentified for Security
- Day One: 55.6M Events

Hacking 101

Low-Level User
Administrator

1. Gain Access to a Computer with a Low-Level User
2. Escalate Privileges (to Administrator)
3. Run Harmful Code
   - Hijack Processes
   - Steal / Destroy Data
   - Breach Other Computers on the Network

Connect Logs By

Event Time

Computer (Host) Name

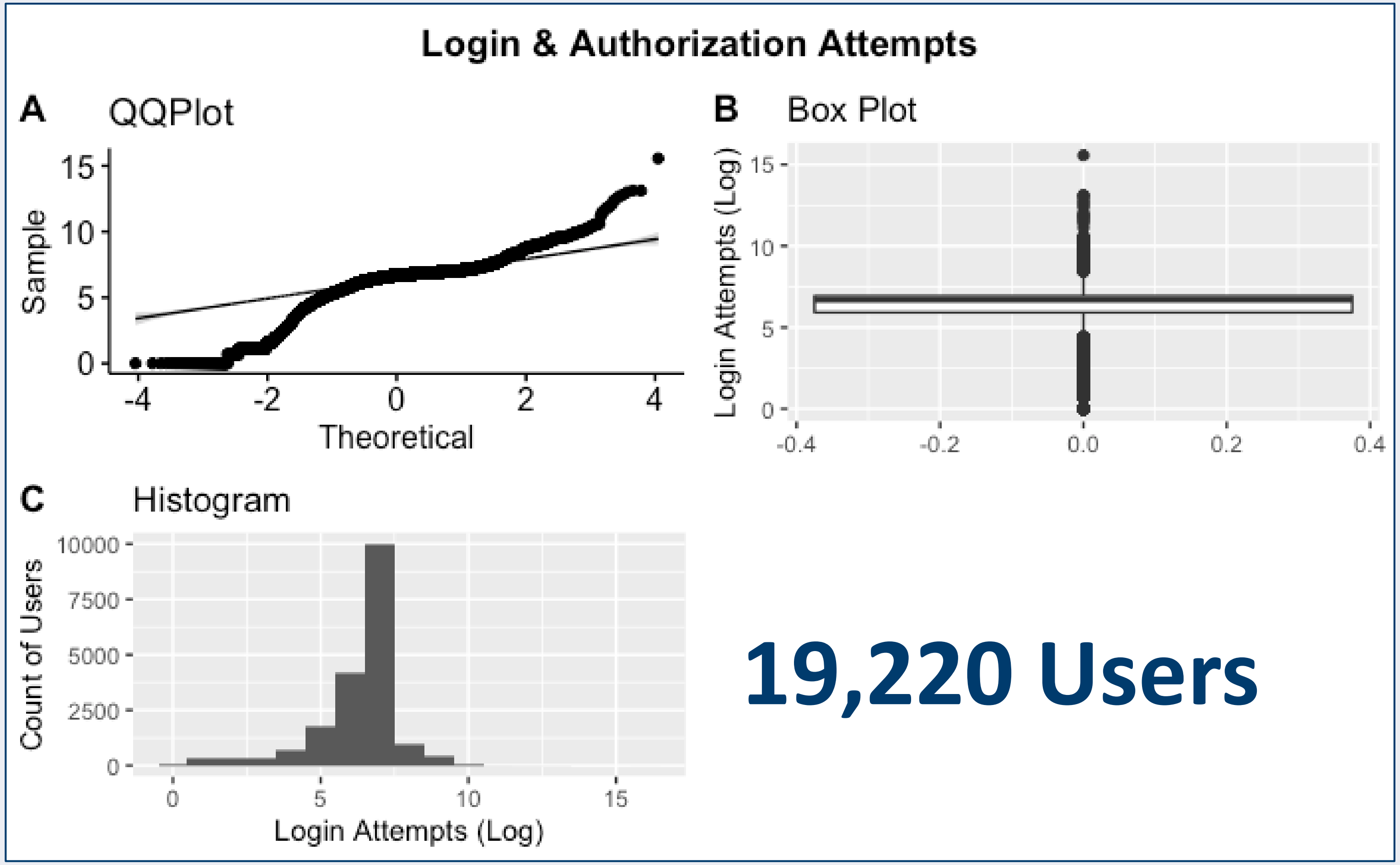
User Name

Logon ID

Computer (Host) Events

- Windows Authentications (Kerberos)
- Logins Using Explicit Credentials
- Login Failures (with Reason Codes)
- Special Privileges Assigned to Login
- Process Started / Stopped
- Computer Locked / Unlocked
- Screen Saver Started / Stopped

Log Aggregation

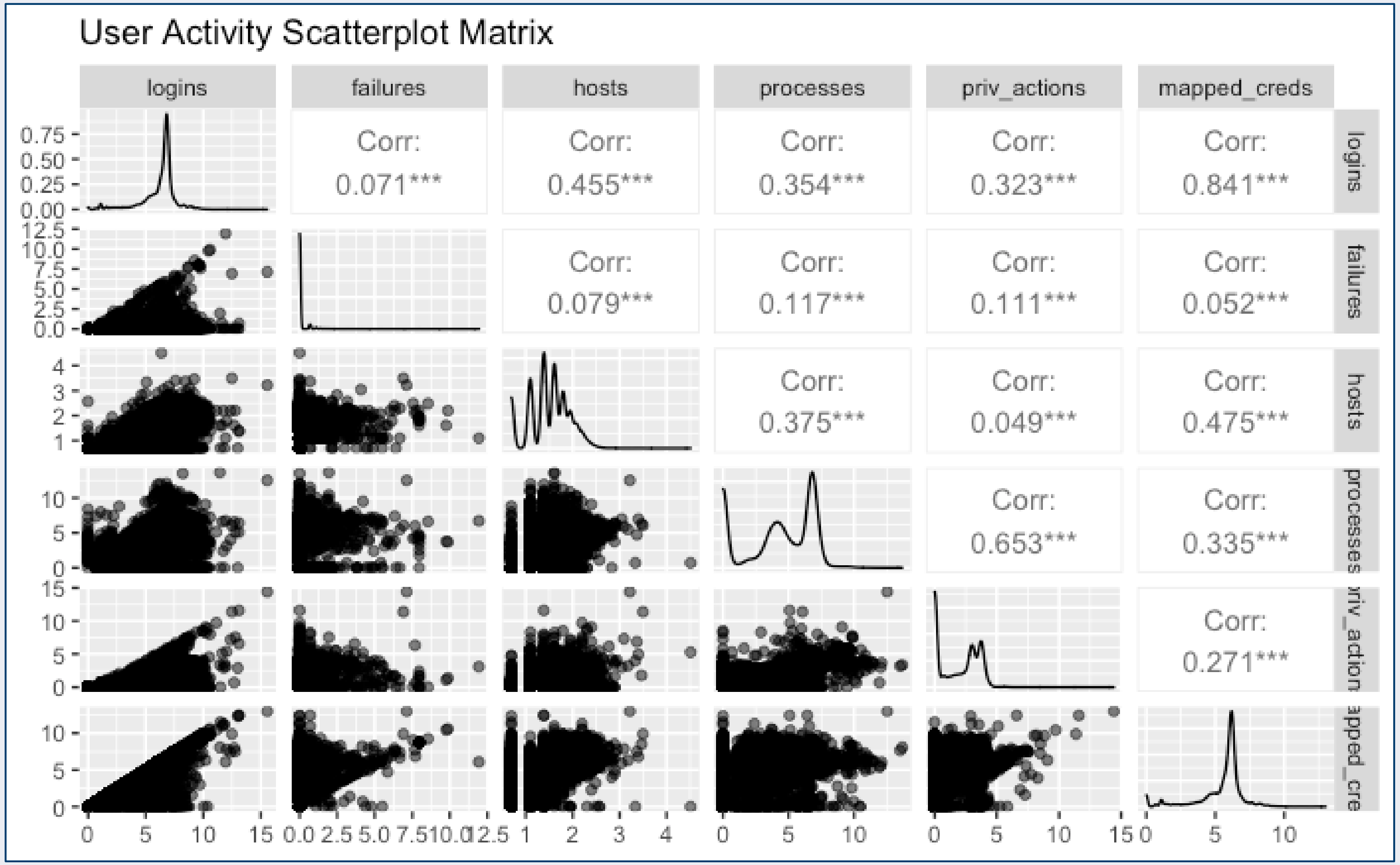


19,220 Users

Counts by User

- Login Attempts
- Login Failures
- Hosts Accessed
- Privileged Actions
- Processes Started
- Mapped Credentials

Variable Check



19,220 Users

Isolation Forest

- First Presented in 2008
- Developed for Anomaly Detection
- Unsupervised Tree Ensemble Method
- Extension of Random Forest
- Scales Well for Large Data Sets

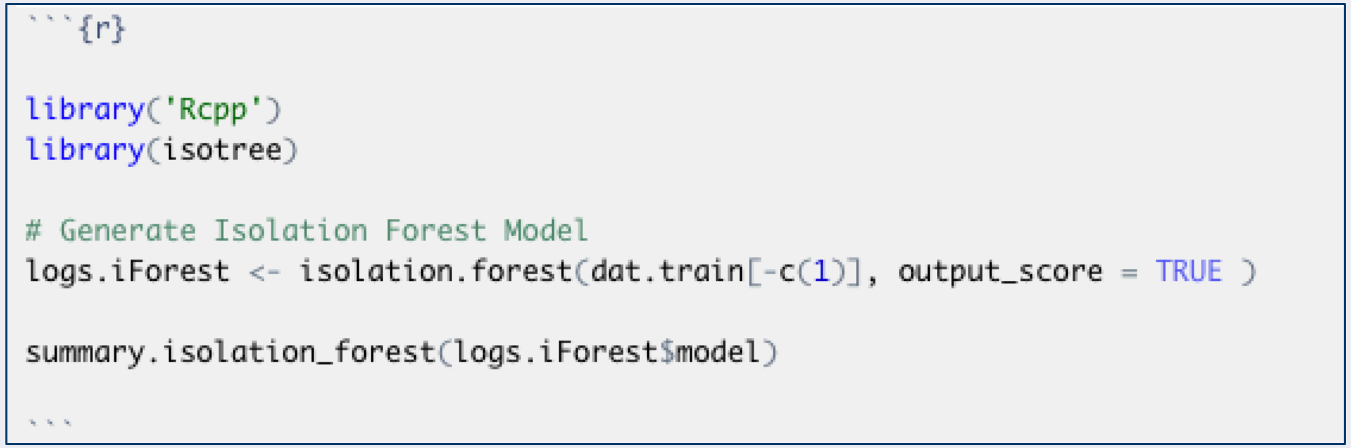
Which One is Different?

Data Requirements

Bad Data? Isolation Forest STILL WORKS

- High-Dimension Problems
- Data is Not Well-Behaved
- Large Number of Irrelevant Attributes
- Small Training Sets
- Training Sets Without Anomalies

isotree Package



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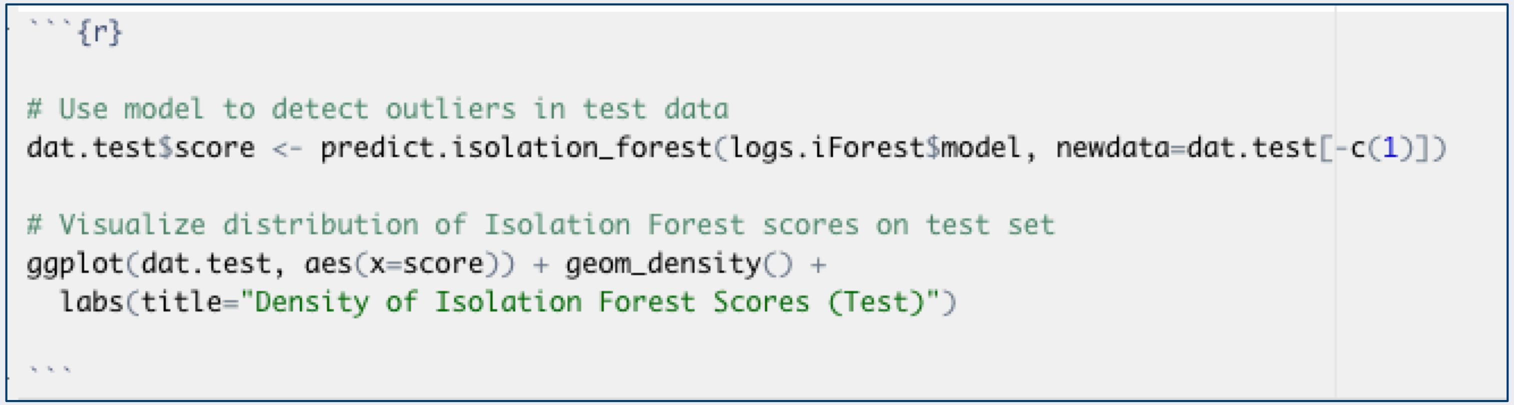
```{r}

library('Rcpp')
library(isotree)

# Generate Isolation Forest Model
logs.iForest <- isolation.forest(dat.train[-c(1)], output_score = TRUE )

summary.isolation_forest(logs.iForest$model)

```
~~~



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```{r}

# Use model to detect outliers in test data
dat.test$score <- predict.isolation_forest(logs.iForest$model, newdata=dat.test[-c(1)])

# Visualize distribution of Isolation Forest scores on test set
ggplot(dat.test, aes(x=score)) + geom_density() +
  labs(title="Density of Isolation Forest Scores (Test)")

```
~~~
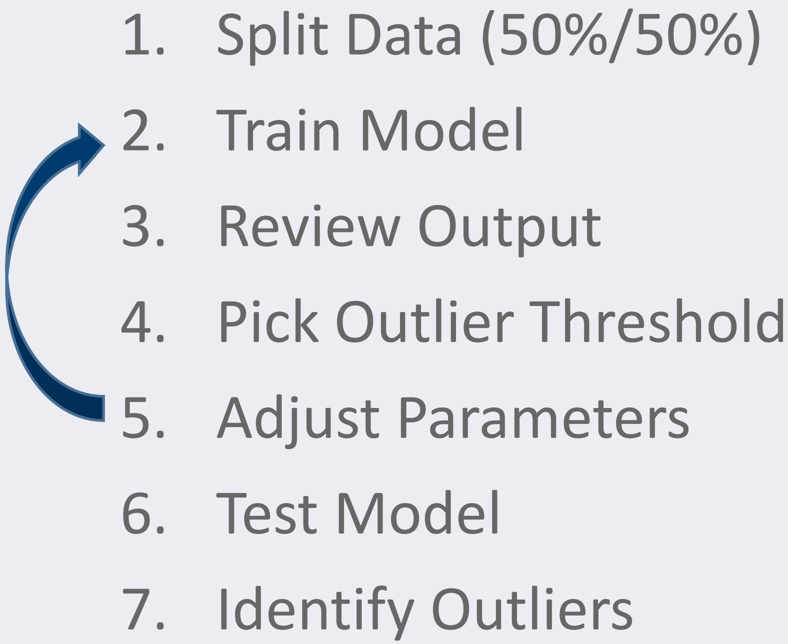
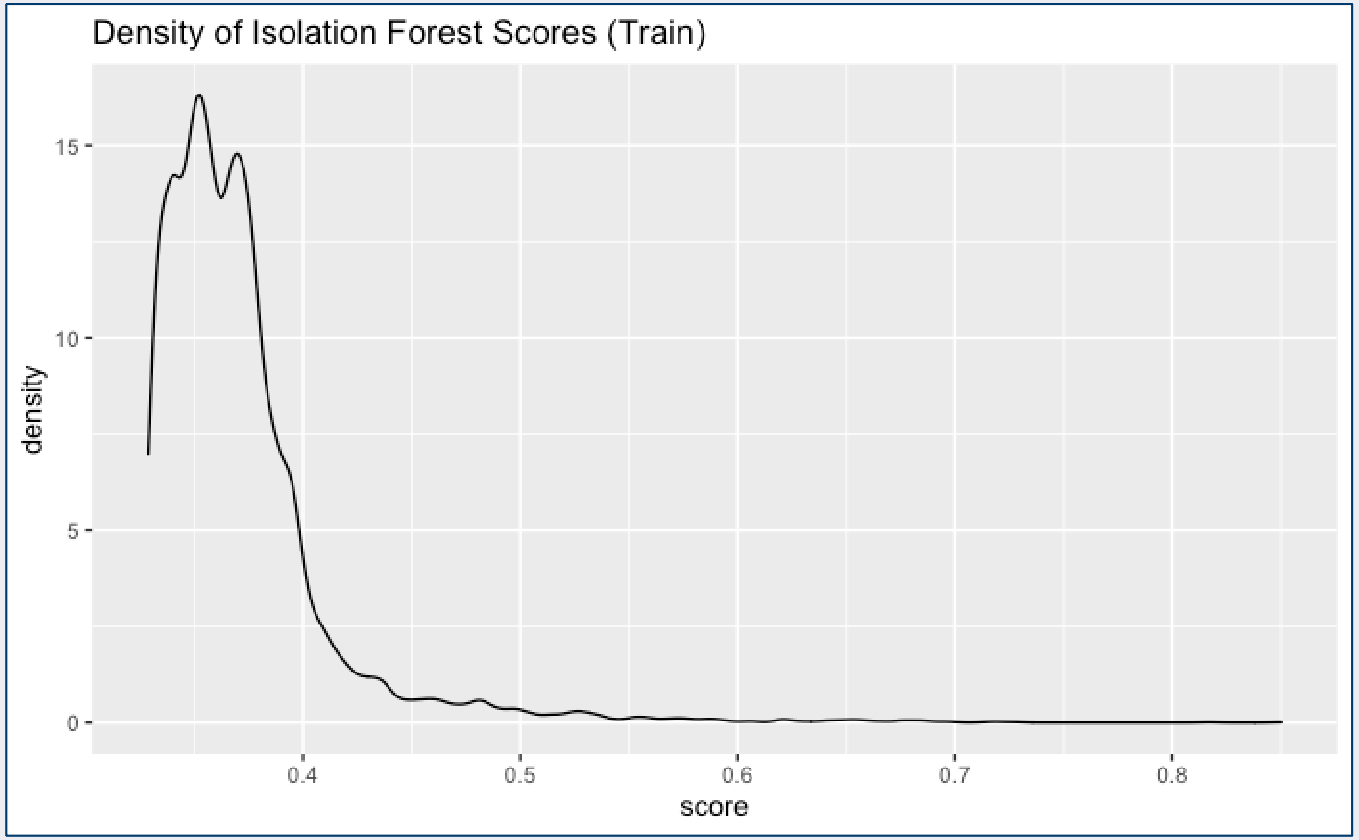

Process



1. Split Data (50%/50%)
2. Train Model
3. Review Output
4. Pick Outlier Threshold
5. Adjust Parameters
6. Test Model
7. Identify Outliers

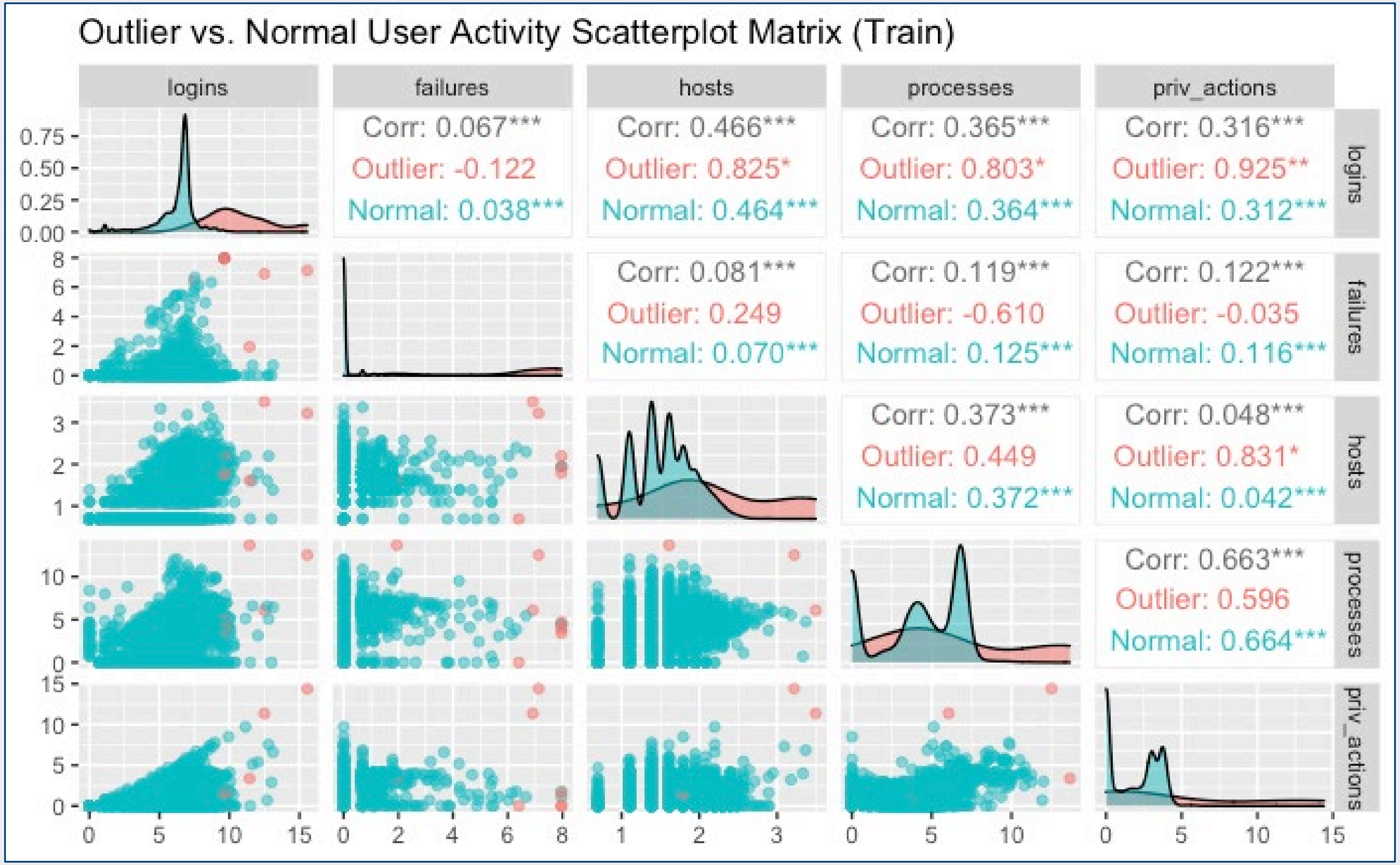
Model Output


Density of Isolation Forest Scores (Train)

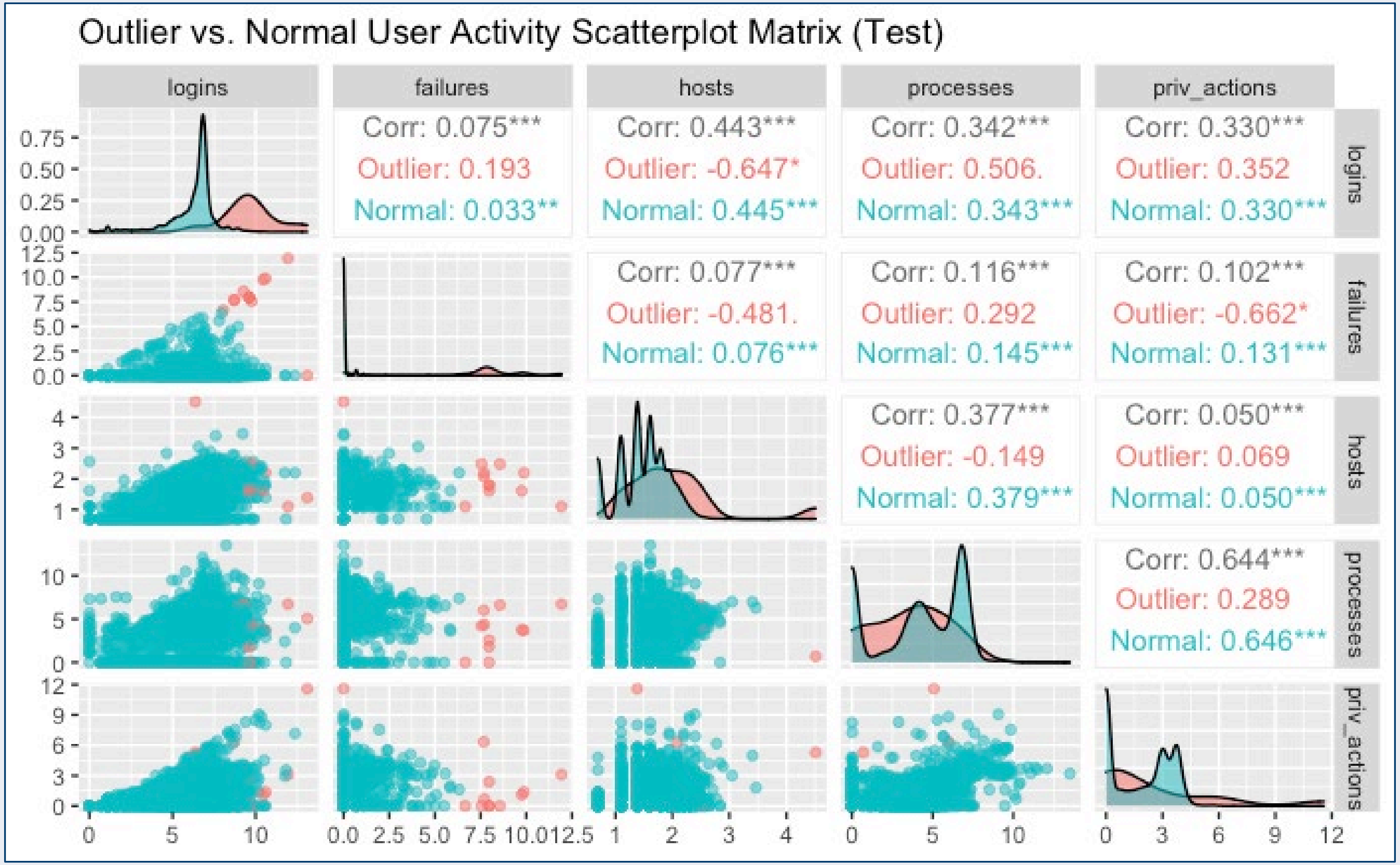
Anomaly Scores

- Generated for Each Observation
- Derived From Average Path Length
- Closer to 0.5 → Normal
- Closer to 1 → Outlier
- Set Outlier Threshold for Analysis (0.7)

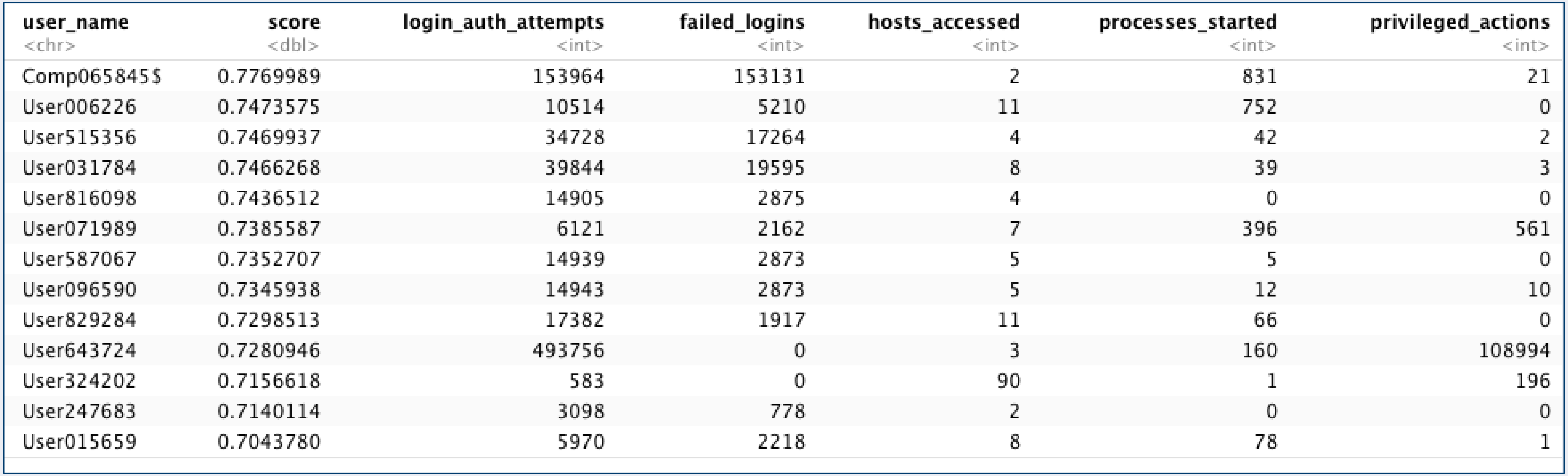
Training Results



Test Results



Anomalous Users



user_name	score	login_auth_attempts	failed_logins	hosts_accessed	processes_started	privileged_actions
<chr>	<dbl>	<int>	<int>	<int>	<int>	<int>
Comp065845$	0.7769989	153964	153131	2	831	21
User006226	0.7473575	10514	5210	11	752	0
User515356	0.7469937	34728	17264	4	42	2
User031784	0.7466268	39844	19595	8	39	3
User816098	0.7436512	14905	2875	4	0	0
User071989	0.7385587	6121	2162	7	396	561
User587067	0.7352707	14939	2873	5	5	0
User096590	0.7345938	14943	2873	5	12	10
User829284	0.7298513	17382	1917	11	66	0
User643724	0.7280946	493756	0	3	160	108994
User324202	0.7156618	583	0	90	1	196
User247683	0.7140114	3098	778	2	0	0
User015659	0.7043780	5970	2218	8	78	1

Discussion

Q & A

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References

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