SFU

Beedie School of Business

BUS 865 Market Risk Management

Clayton Copula:
Estimation and Simulation For Verizon and AT&T

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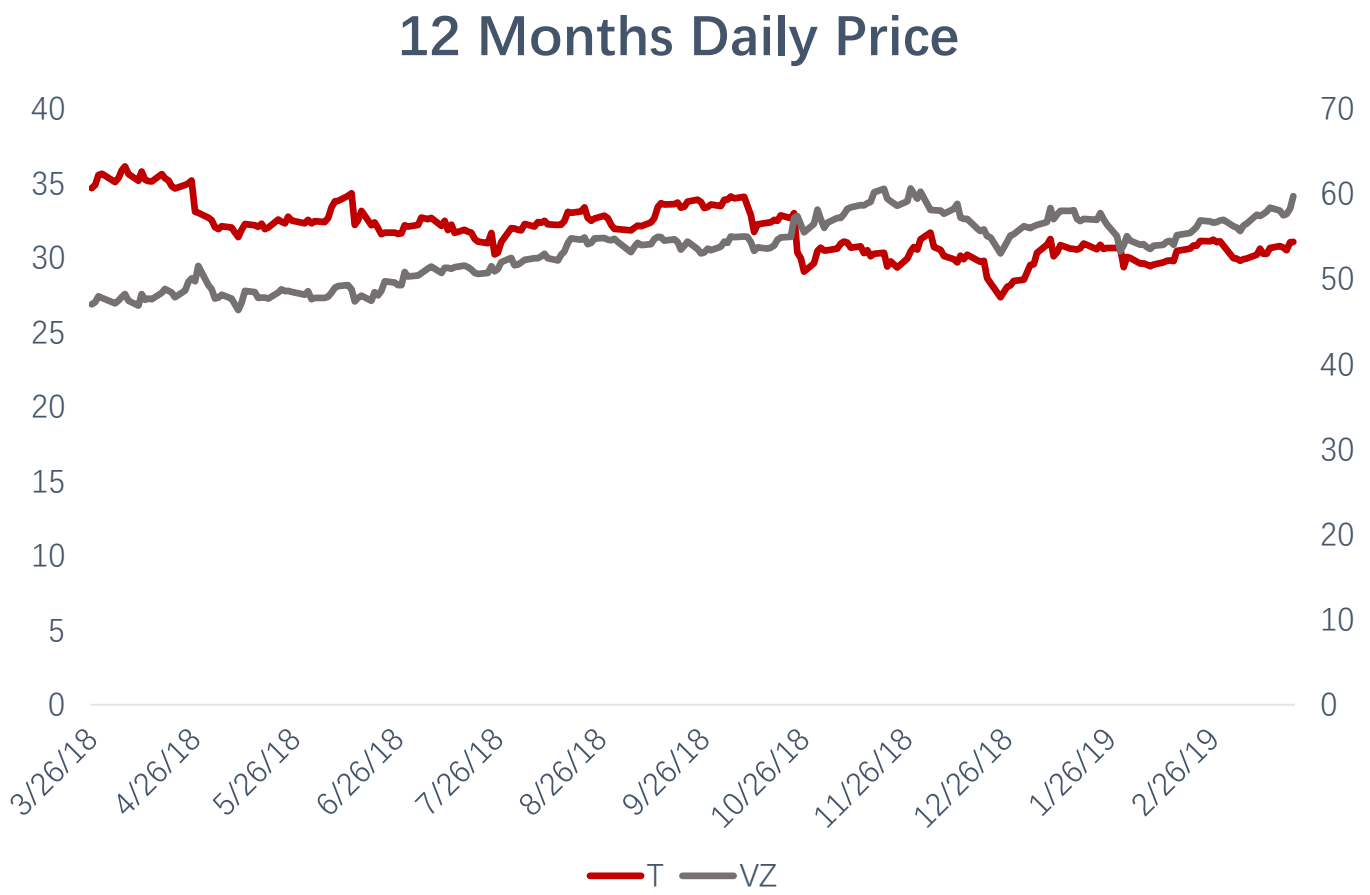
Company Introduction

verizon

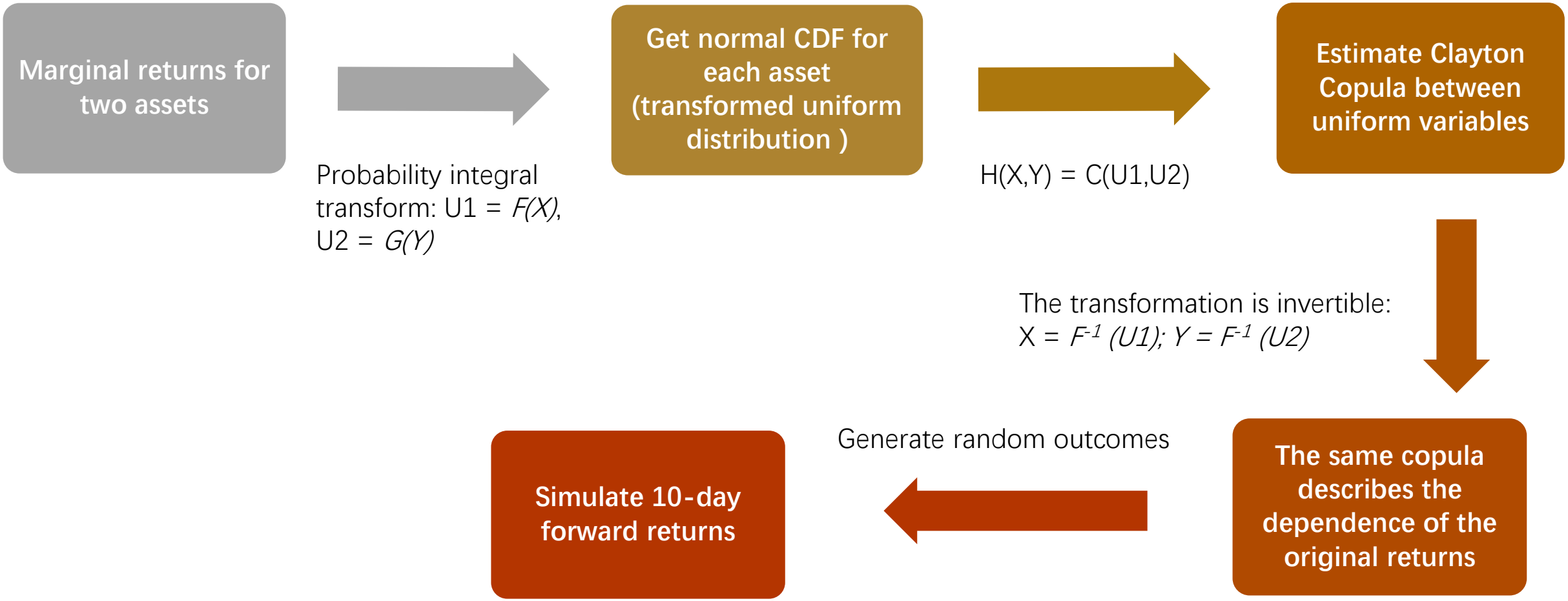
- **247.6B MKT CAP**
- The largest wireless telecommunications provider in the United States

AT&T

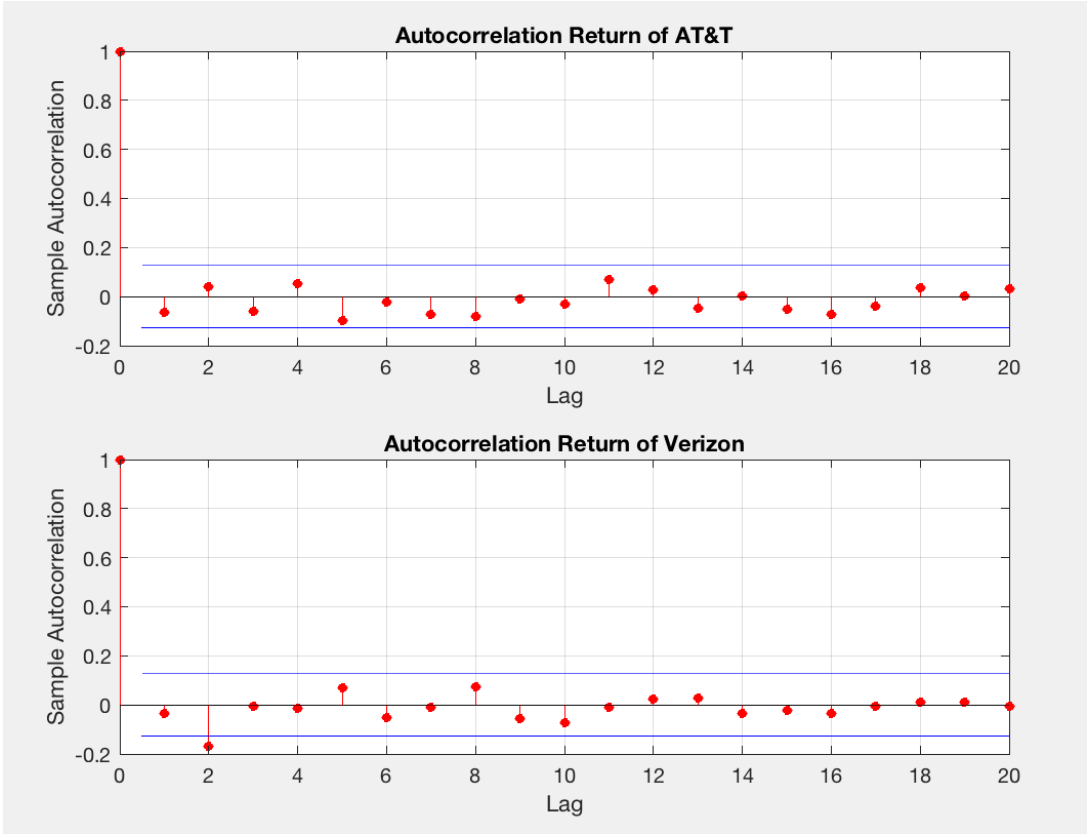
- **223.7B MKT CAP**
- The second largest provider of mobile telephone services in the United States.

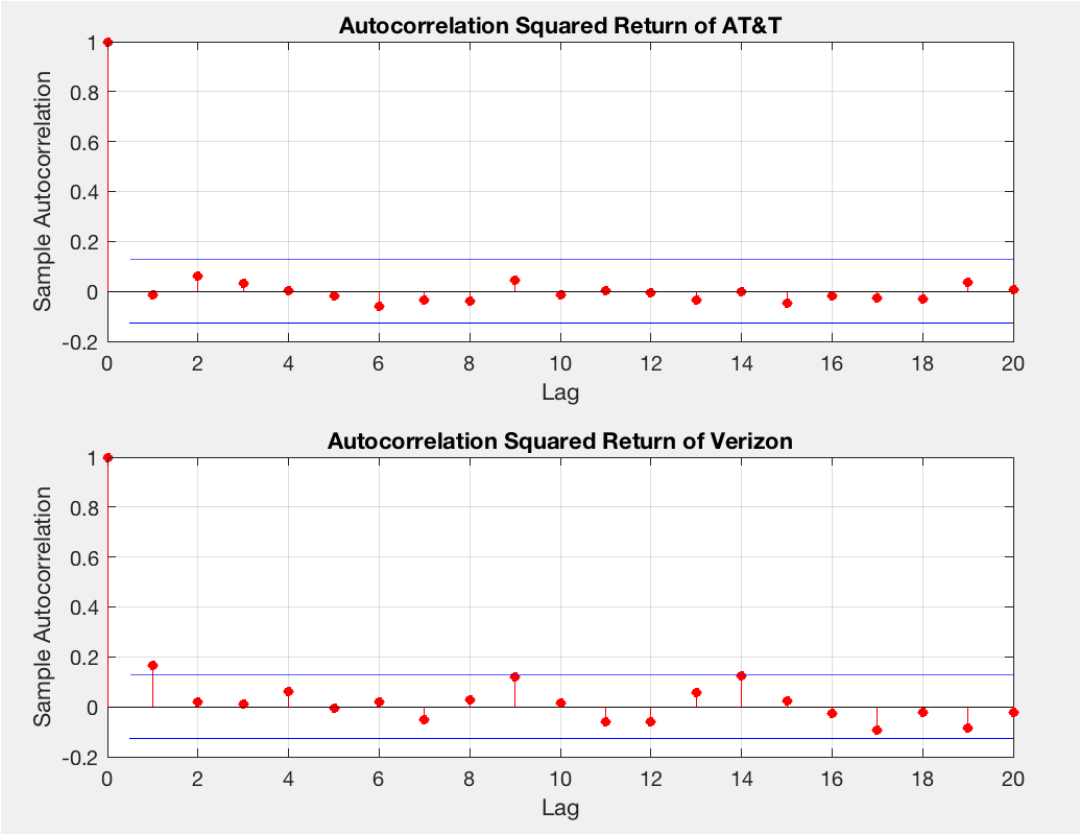


Methodology



Daily data for AT&T and Verizon with no serial correlation and no heteroscedasticity



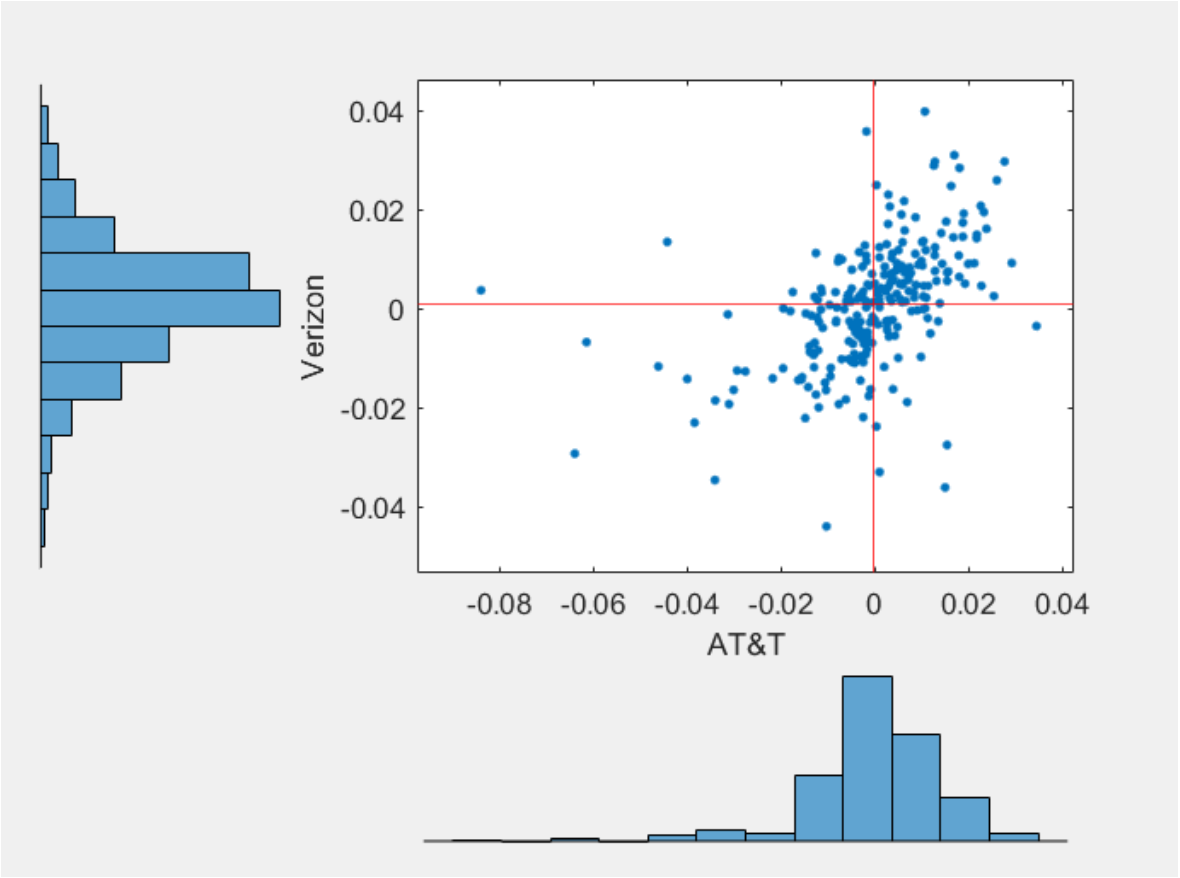


Marginal Distributions of Returns

Scatterhist (AT&T Returns, Verizon Returns)

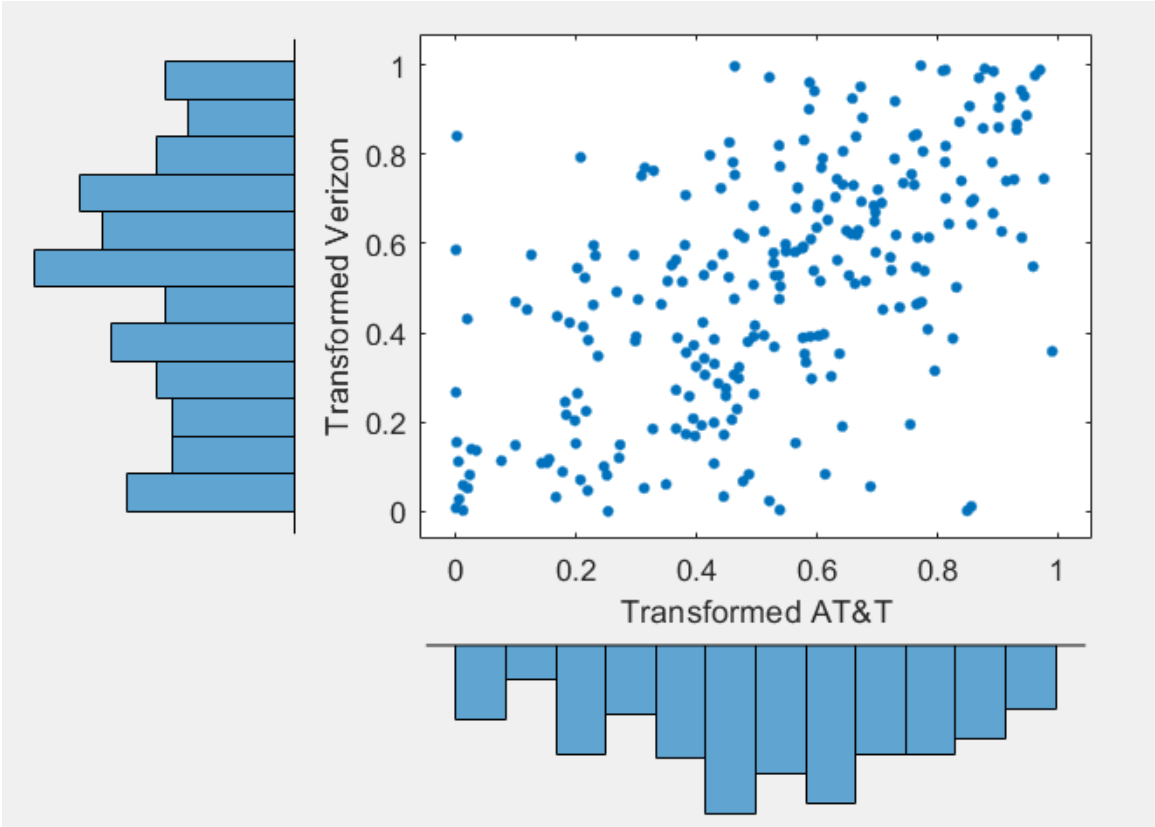
- Marginal Distribution of AT&T Returns was left skewed.
- Marginal Distribution of Verizon Returns was slightly left skewed.
- Scatter plot between two Returns

We chose Clayton Copula - exhibiting greater dependence in the negative tail than in the positive



Uniform Distribution of each asset - Probability integral transformation

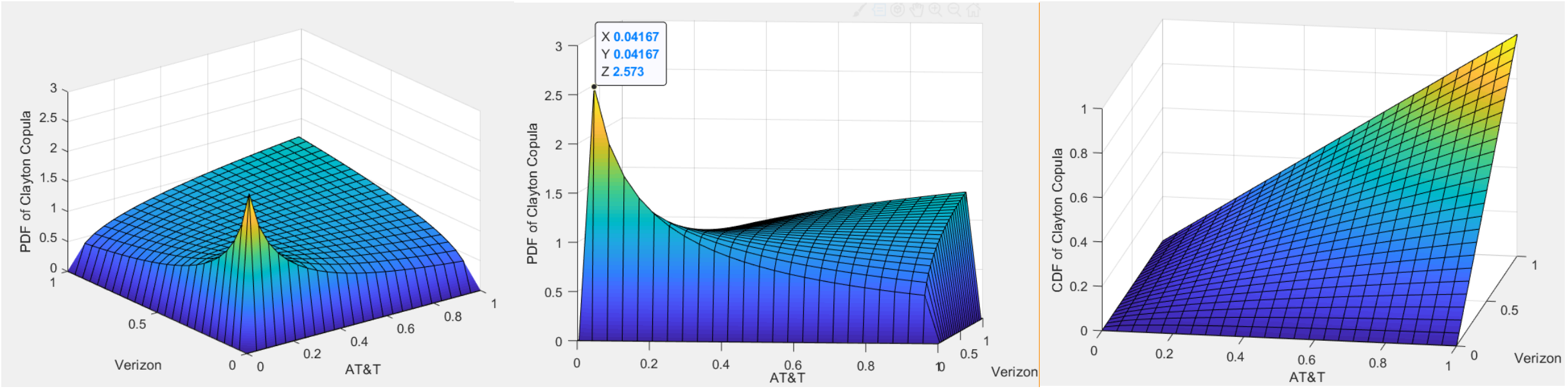
```
% estimate normal CDF for AT&T Returns to
% convert data to uniform distribution
[muT,sigmaT] = normfit (TReturn);
uT = normcdf (TReturn, muT, sigmaT);

% repeat for Verizon Returns
[muVZ,sigmaVZ] = normfit (VZReturn);
uVZ = normcdf (VZReturn, muVZ, sigmaVZ);

% standardized scatter plot between two returns
Scatterhist (uT,uVZ);
```



Estimate Clayton Copula

% Get probability distribution on the unit cube of uniform variables
[Theta] = copulafit('Clayton',[uT uVZ]);

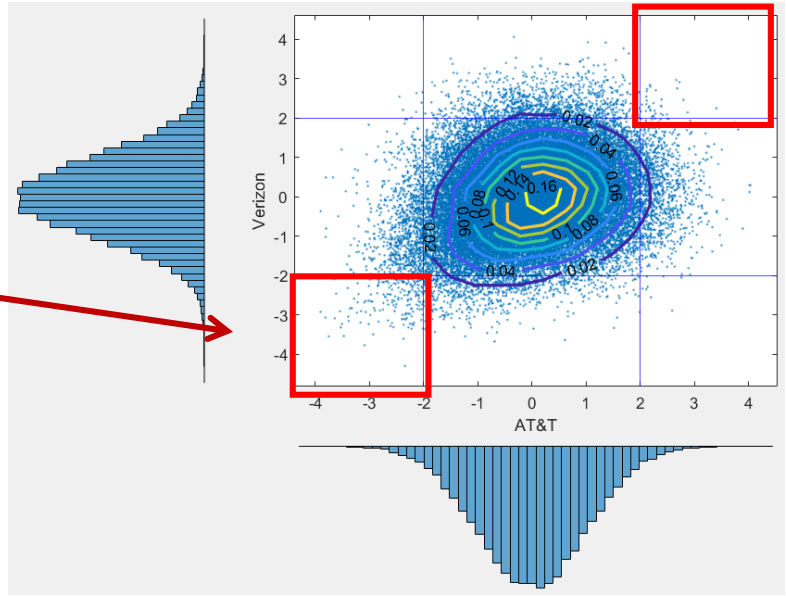
% output parameter of Clayton Copula
Theta = 0.3298



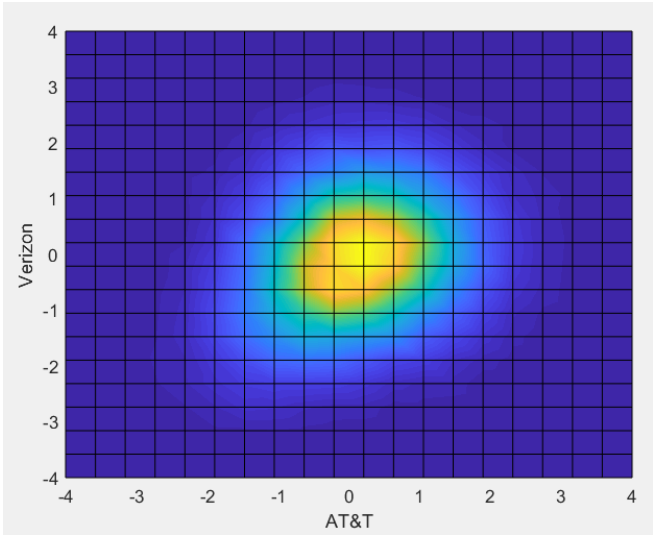
Fitted Clayton Copula on Returns – PDF and Contour

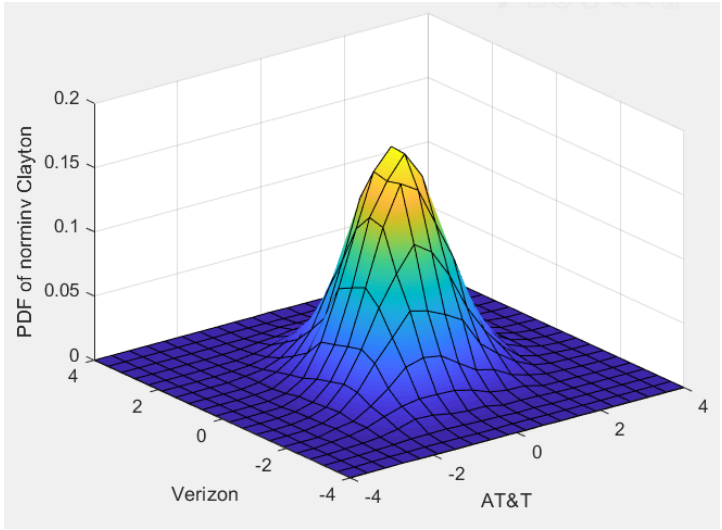
50000 random results from Clayton copula.

- Exhibiting greater dependence in the negative tail than in the positive tail.
- However, companies with big cap still showed their steadiness in bad situation.

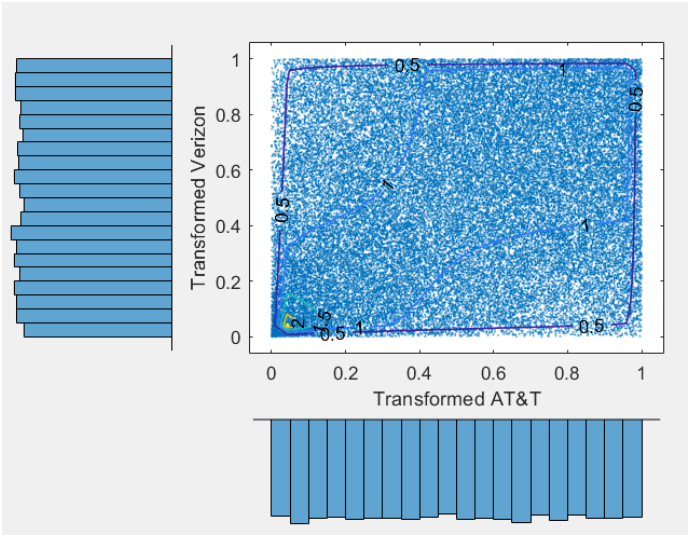


Probability Density Plot





Scatterplot of Uniform Marginal Distribution



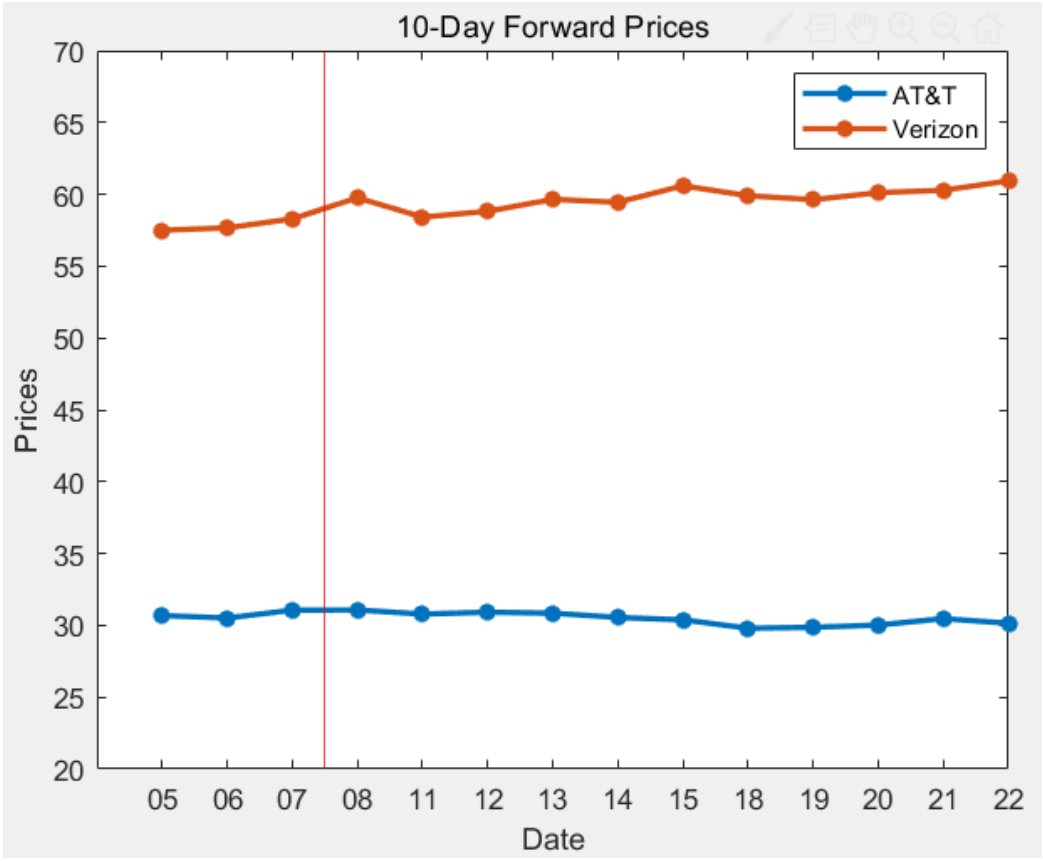
Forward Pricing of Individual Assets

Every outcome was randomly generated. We assume they were time independent. Every outcome was not relative to previous one. Therefore, the 10 random outcomes can represent the 10-day forward simulation for two assets' returns.

Simulation:

- Use fucntion copularnd to do 10-days simulation
- Use function norminv to generate returns

```
rndu = copularnd('Clayton',Theta,10);
mu = [muA muV];
sigma = [sigmaA sigmaV];
rndReturn = norminv(rndu,repmat(mu,10,1),repmat(sigma,10,1));
rnfPx = ret2price(rndReturn, Price(end,:));

figure(12)
plot(1:14,[Price(end-3:end,:);rnfPx(2:end,:)],'linewidth',2,'Marker','*');
ylim([20 70]);
xticks(1:14);
xticklabels(datestr(Date(end-13:end),7));
legend('AT&T','Verizon');
title('10-Day Forward Prices');
```



Thank you!

Q & A