

# 2020 Annual Conference

July 2020

# AGENDA

1. What is it?
2. How does it work?
3. How it can be used
4. Case Studies
5. Questions

# WHAT IS CLUSTER ANALYSIS?

Take a complex set of data...



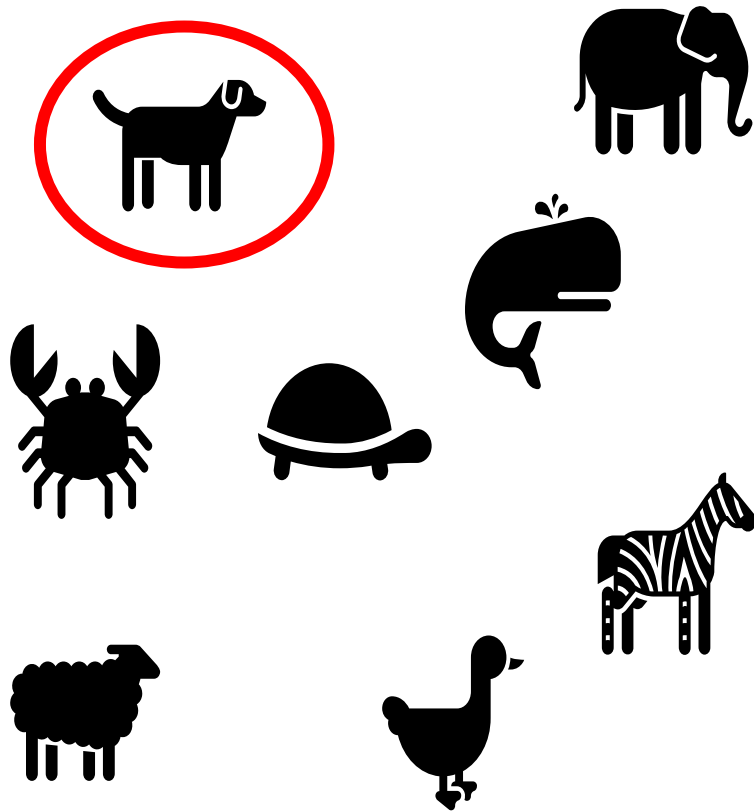
Find groups and natural order



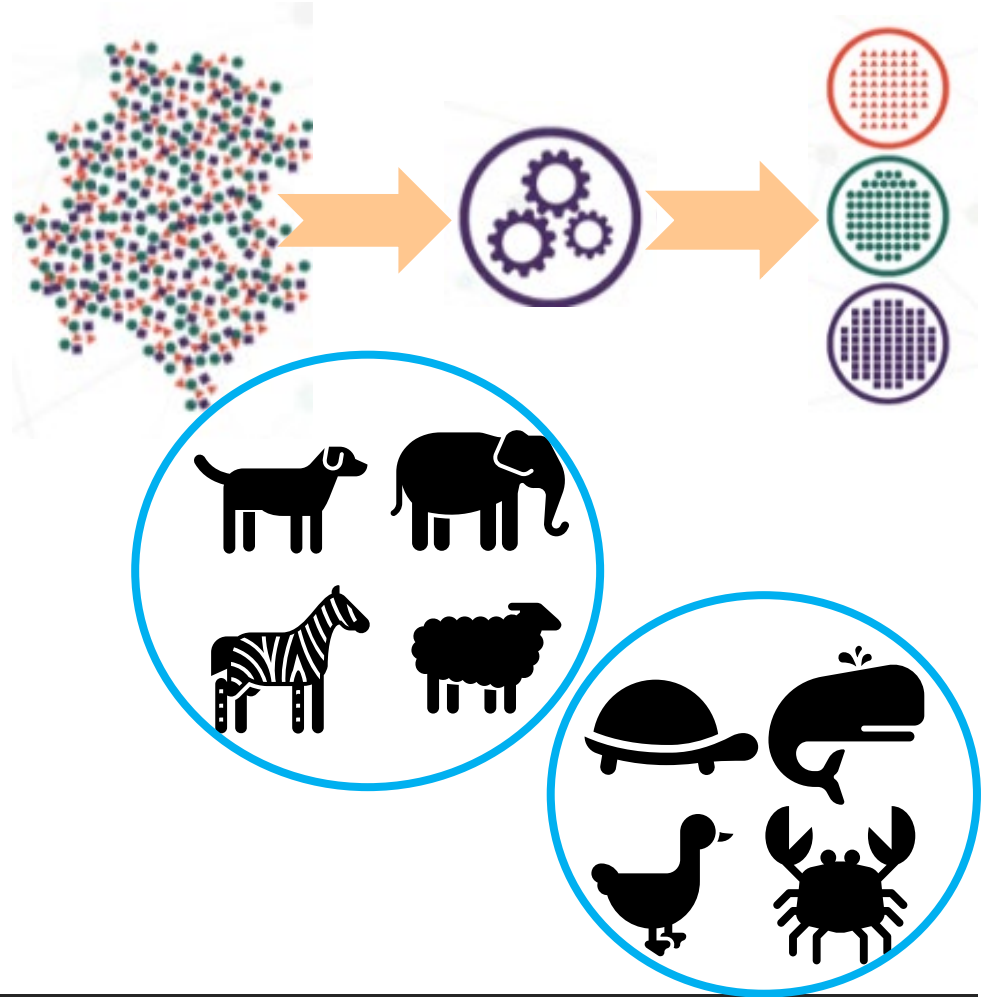


# SUPERVISED vs UNSUPERVISED MACHINE LEARNING

Supervised

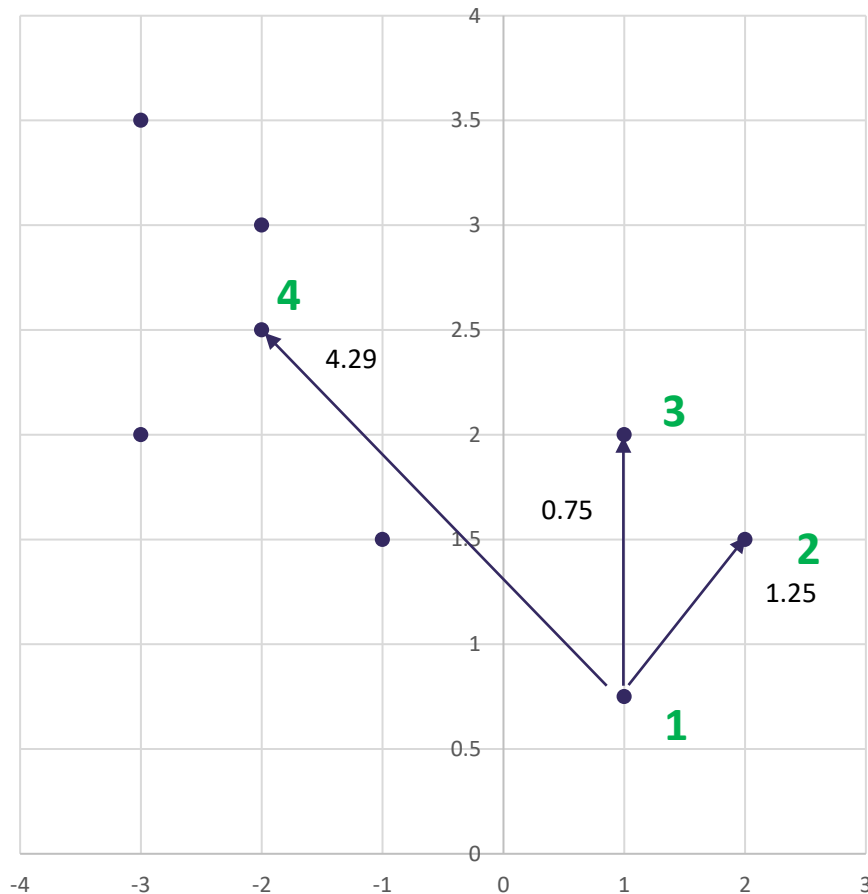


Unsupervised

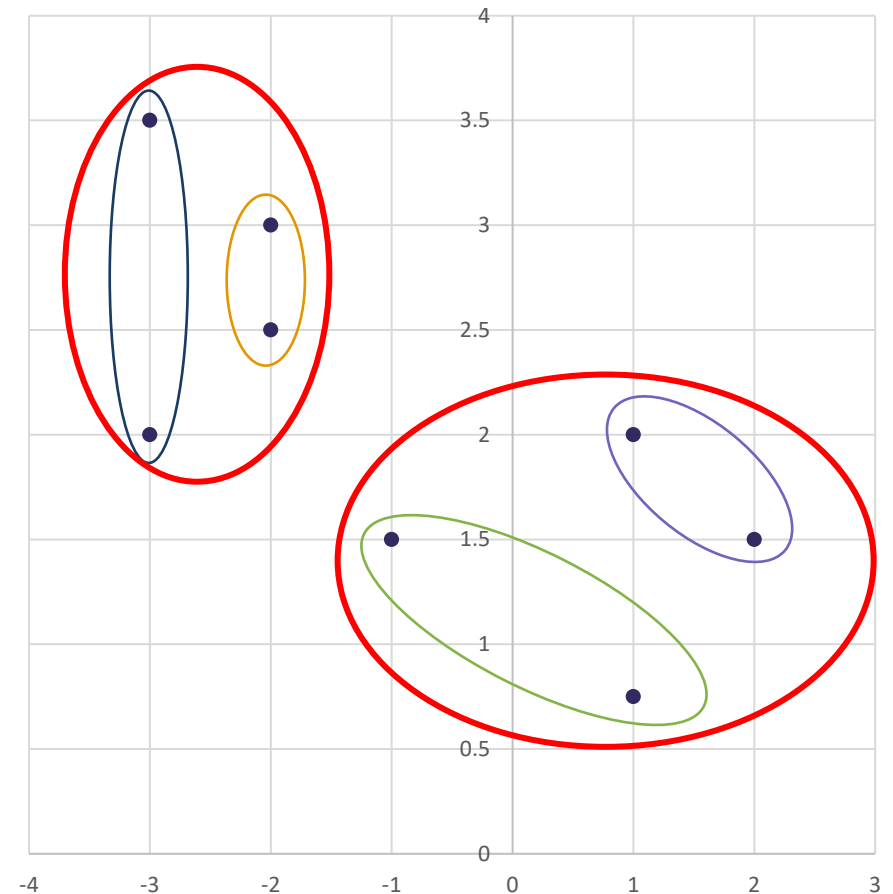


# CLUSTER ANALYSIS – How does it work?

Raw Data



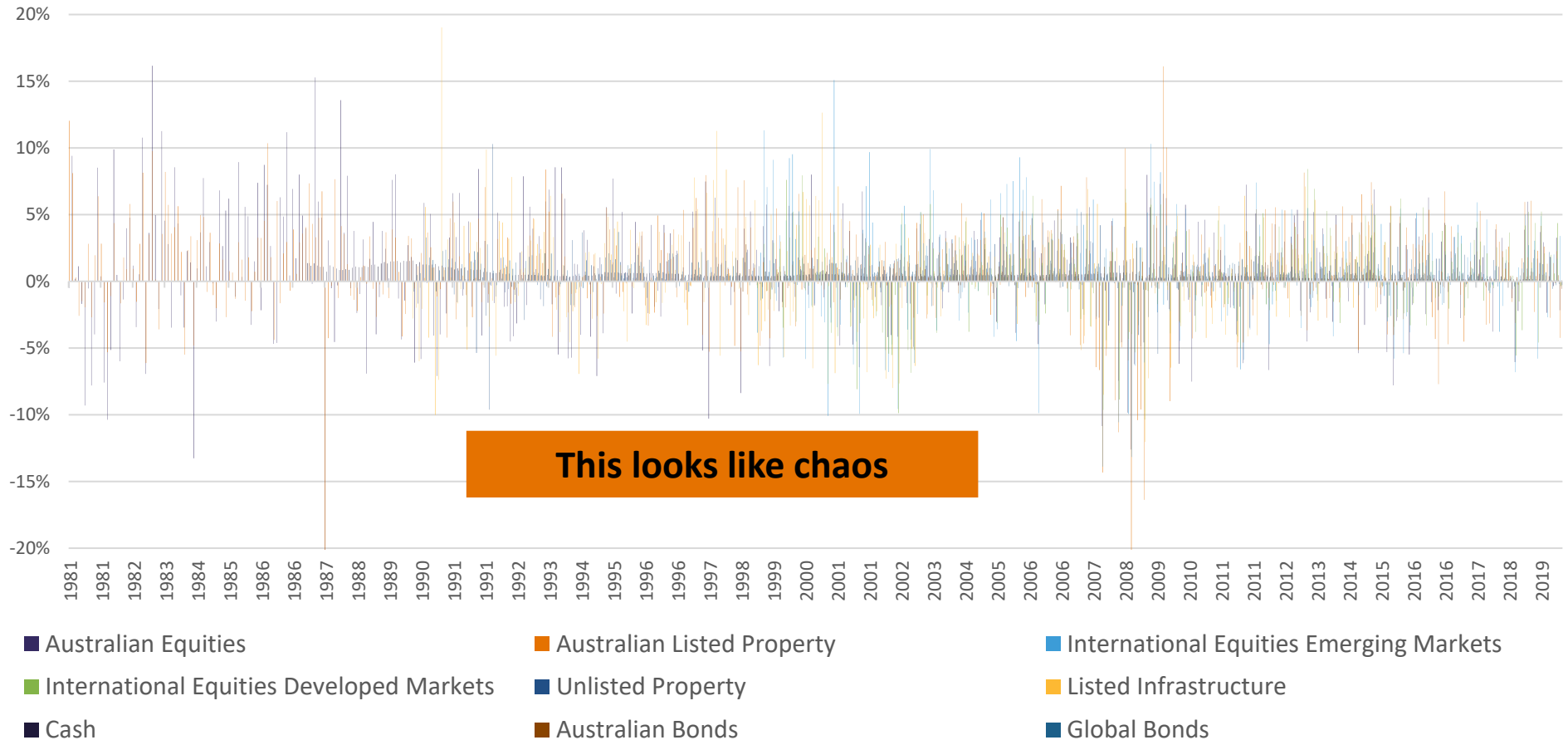
Clustered Data



Source: Frontier

# CLUSTER ANALYSIS – How it can be used

Time Series of Major Asset Class Index Returns



Source: Frontier, Bloomberg. Data is from 1981 to December 2019

# CLUSTER ANALYSIS – How it can be used (cont)

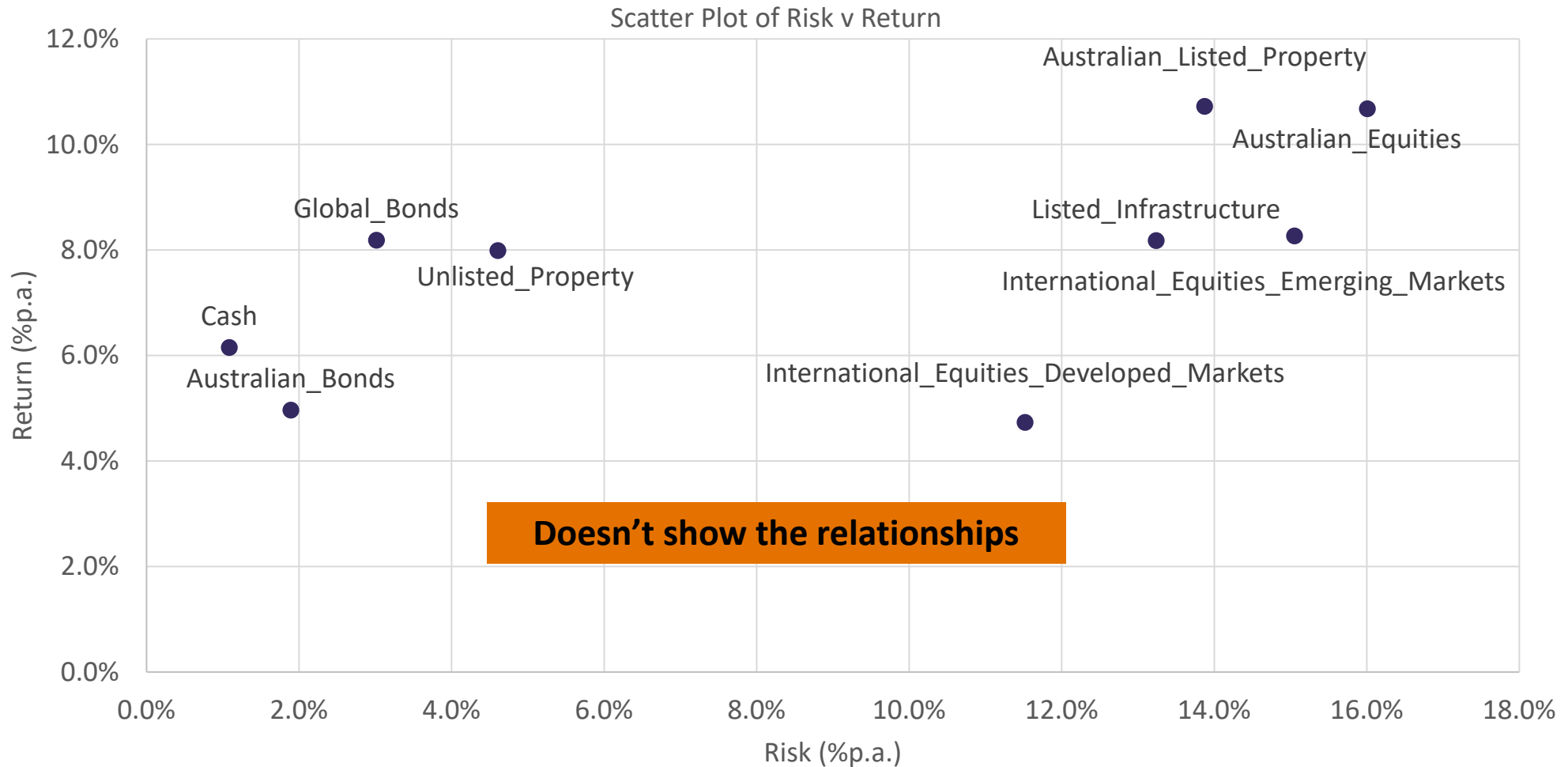
Correlation Matrix of Index Returns

	Australian Equities	Australian Listed Property	International Equities Emerging Markets	International Equities Developed Markets	Unlisted Property	Listed Infrastructure	Cash	Australian Bonds	Global Bonds
Australian Equities	1.00								
Australian Listed Property	0.62	1.00							
International Equities Emerging Markets	0.64	0.30	1.00						
International Equities Developed Markets	0.52	0.37	0.67	1.00					
Unlisted Property	-0.04	-0.01	0.02	0.03	1.00				
Listed Infrastructure	0.17	0.27	0.13	0.53	0.05	1.00			
Cash	0.00	-0.02	-0.09	-0.16	-0.17	-0.01	1.00		
Australian Bonds	-0.24	0.06	-0.30	-0.17	-0.08	0.12	0.34	1.00	
Global Bonds	0.10	0.25	-0.17	-0.26	-0.18	0.22	0.23	0.49	1.00

**Relationships a bit clearer  
Now, how do we determine  
allocations**

Source: Frontier, Bloomberg. Correlation data is based on time series Index returns for the period 1981 to December 2019

# CLUSTER ANALYSIS – How it can be used (cont)

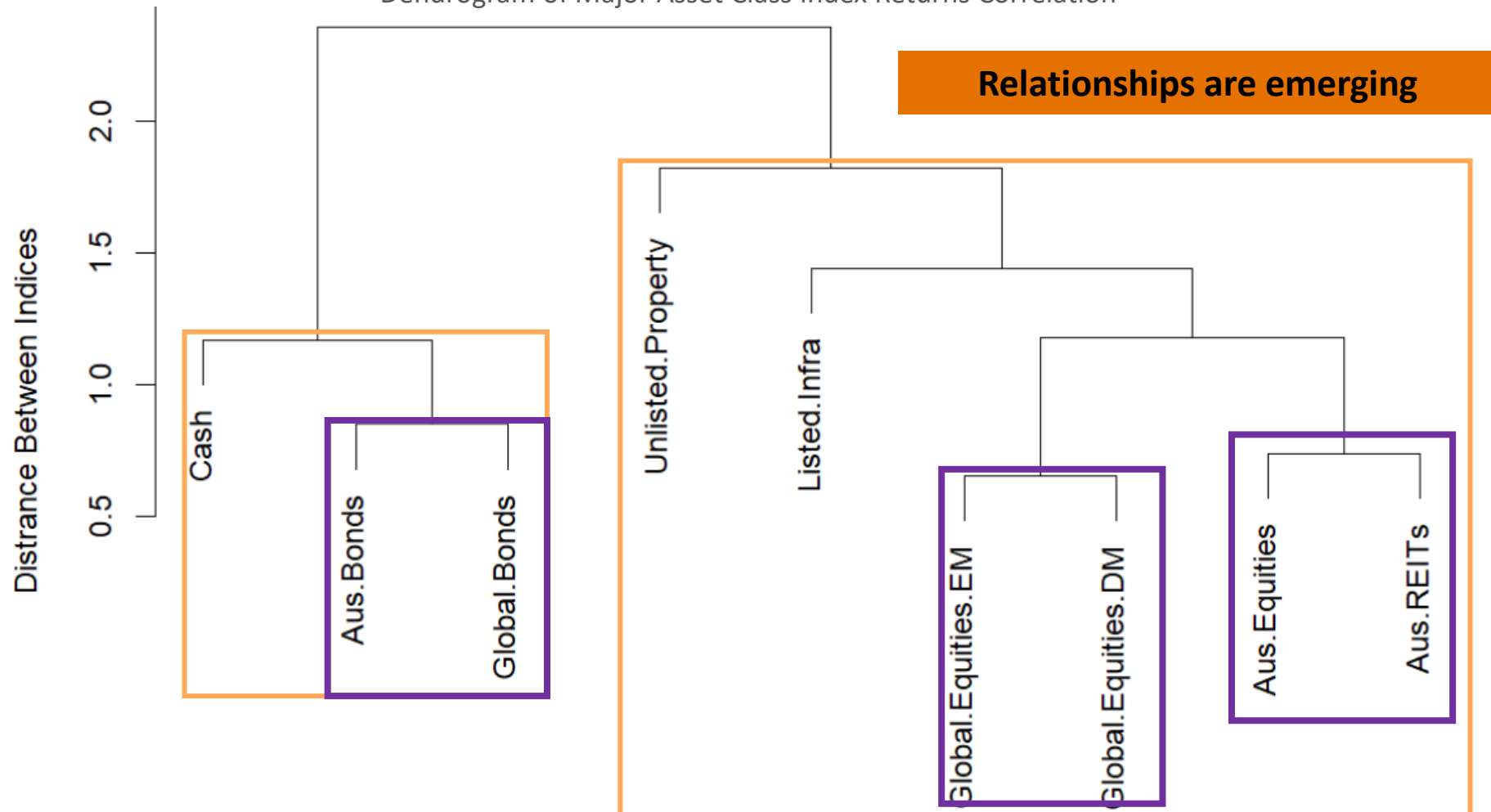


Source: Frontier, Bloomberg. Data is from 1981 to December 2019. Risk and return metrics are annualized since 1981 or inception of the return date



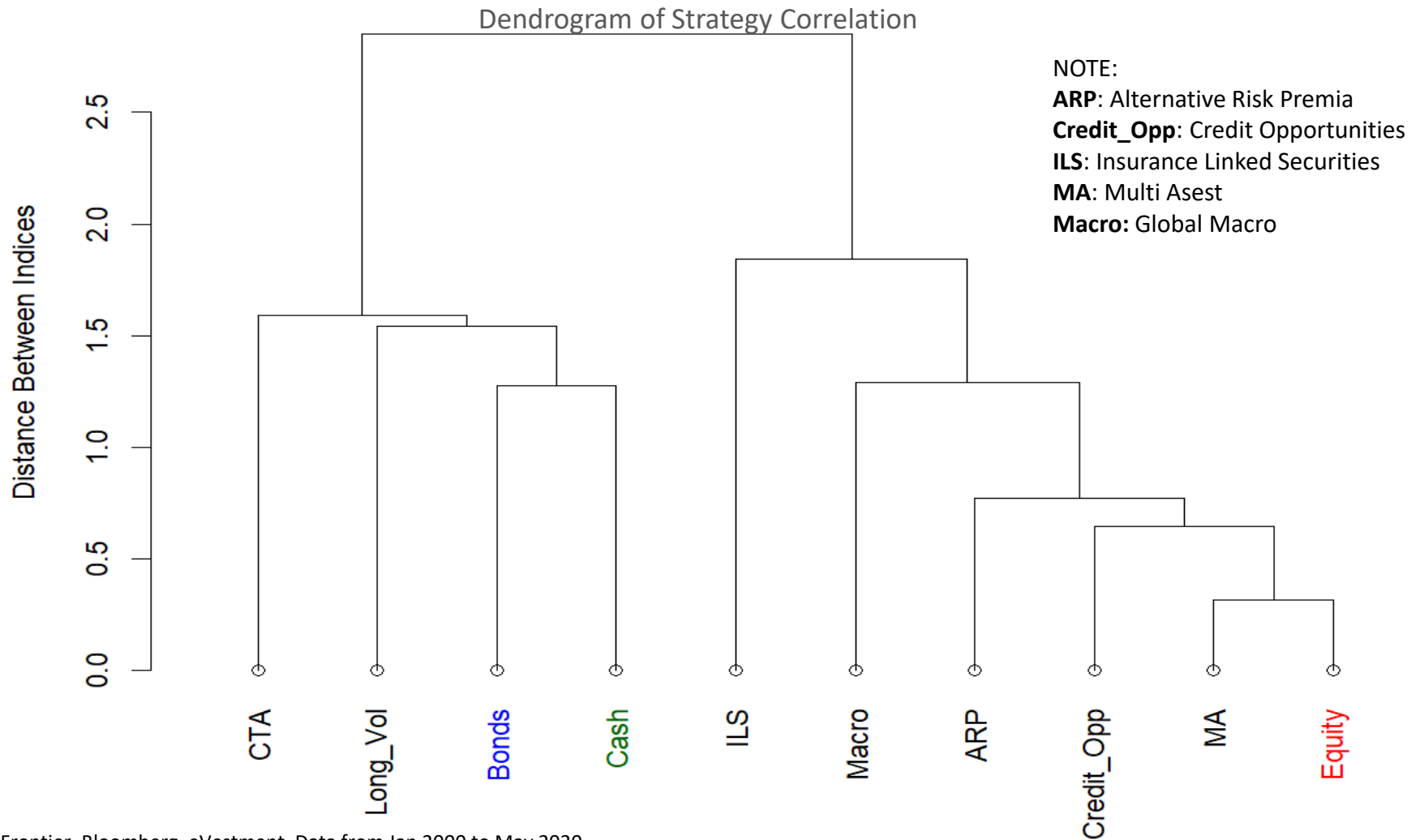
# CLUSTER ANALYSIS – How it can be used

Dendrogram of Major Asset Class Index Returns Correlation



Source: Frontier, Bloomberg. Dendrogram is based on correlation matrix of asset class index returns from 1981 to December 2019

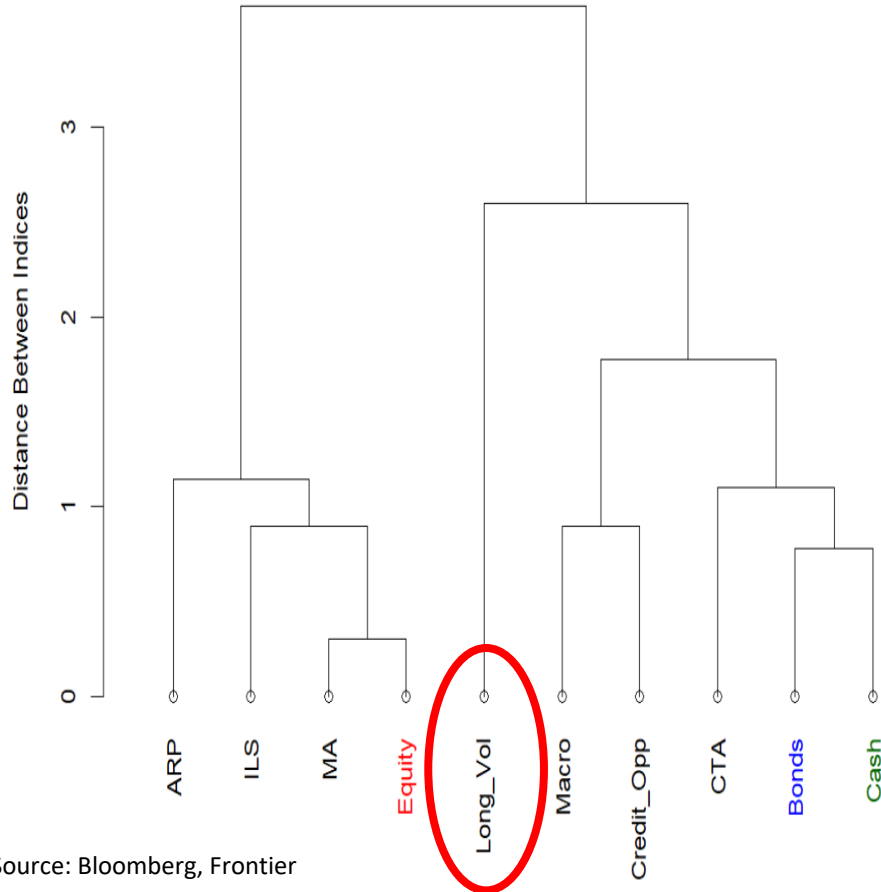
# CASE STUDY 1: ALTERNATIVE SECTOR SUB-STRATEGY CLUSTERS



Source: Frontier, Bloomberg, eVestment. Data from Jan 2000 to May 2020

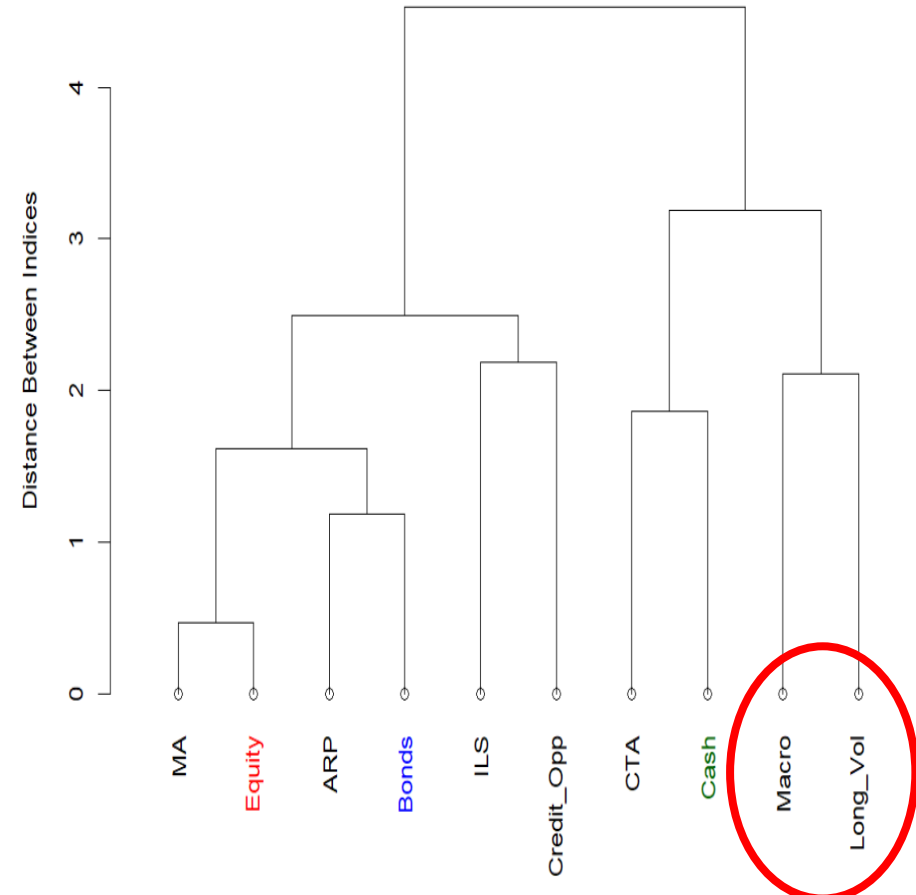
# CASE STUDY 1: STRATEGY CLUSTERS ARE NOT STATIC

Dendrogram of Strategy Correlation 2019



Source: Bloomberg, Frontier

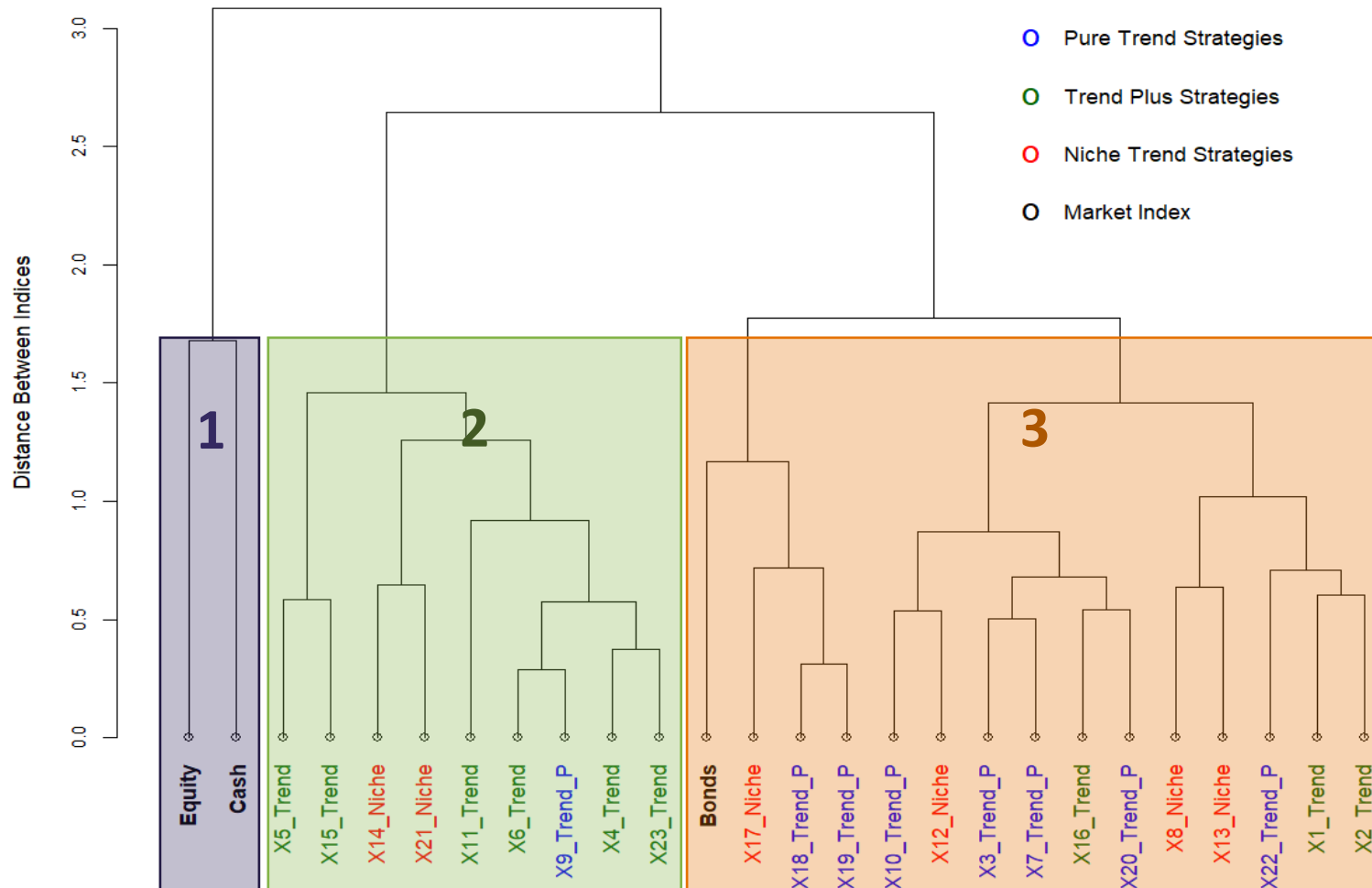
Dendrogram of Strategy Correlation 2020



**Relationships change over time, cluster analysis deeply interrogates these relationships**

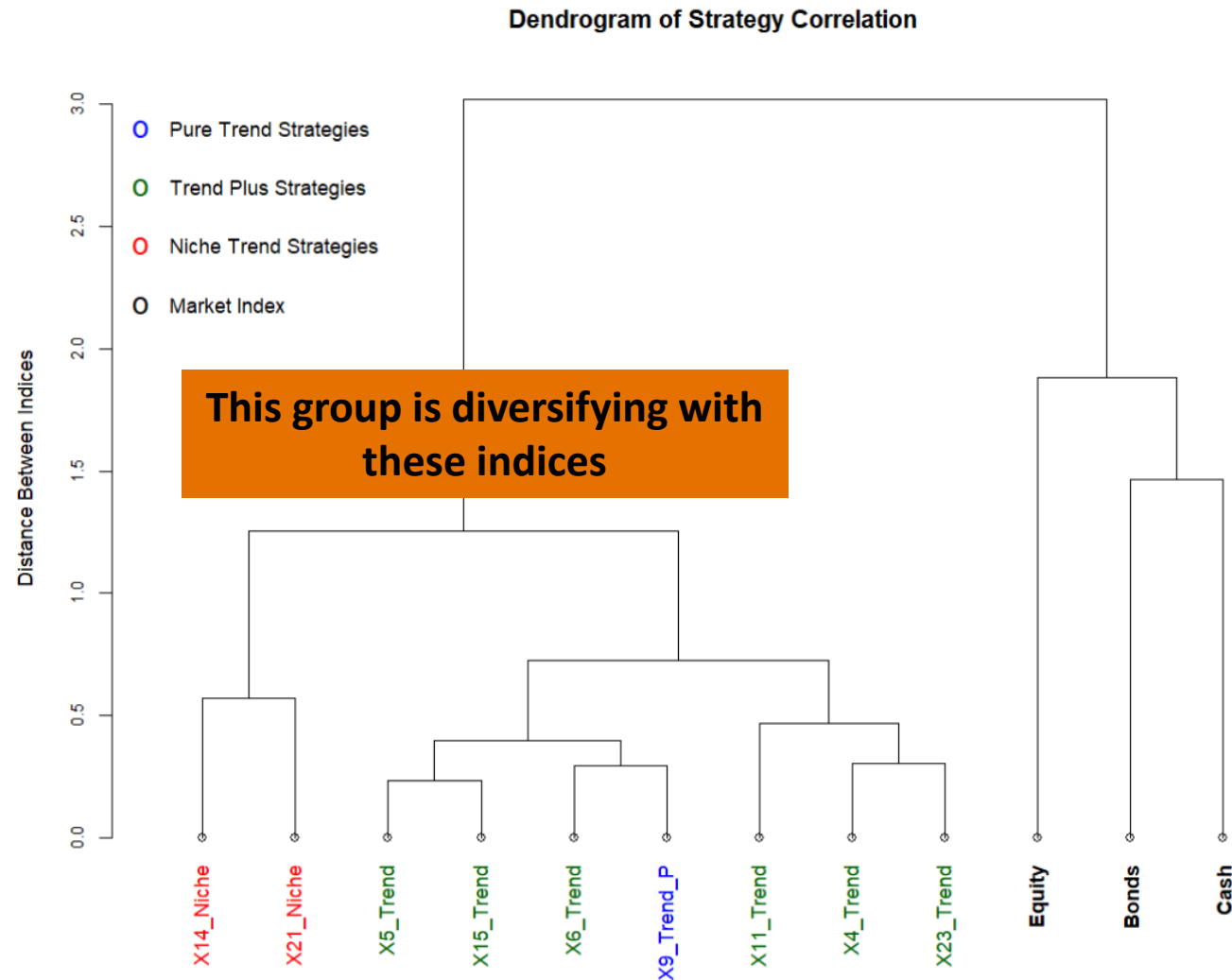
# CASE STUDY 2 – MANAGER SELECTION; TRUE TO LABEL?

Dendrogram of Strategy Correlation



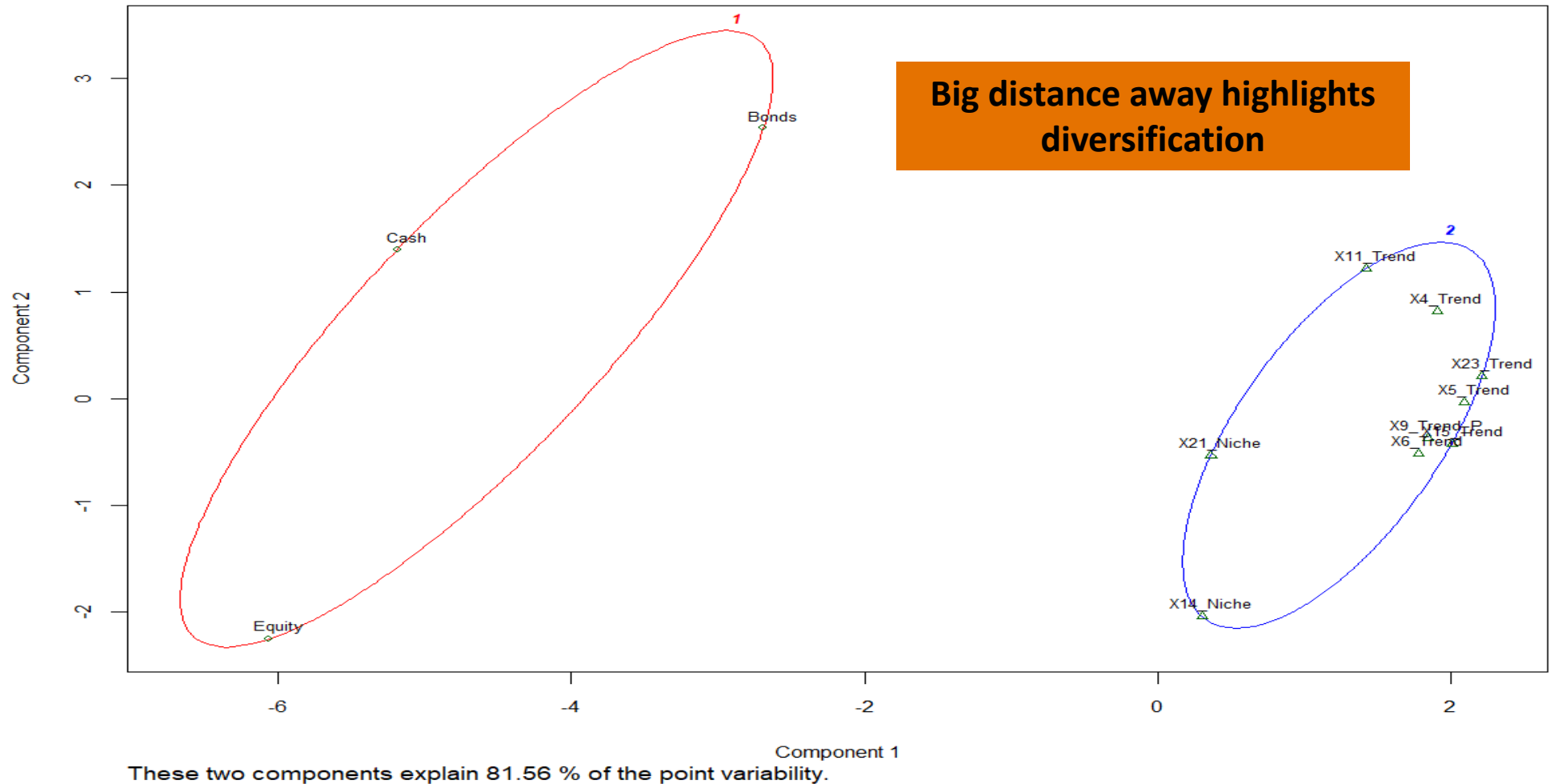
Source: Bloomberg, Frontier, Managers. Data 2000 (or since inception) to May 2020

# CASE STUDY 2– CTA Managers; subset for selection



# CASE STUDY 2 – Subset for selection

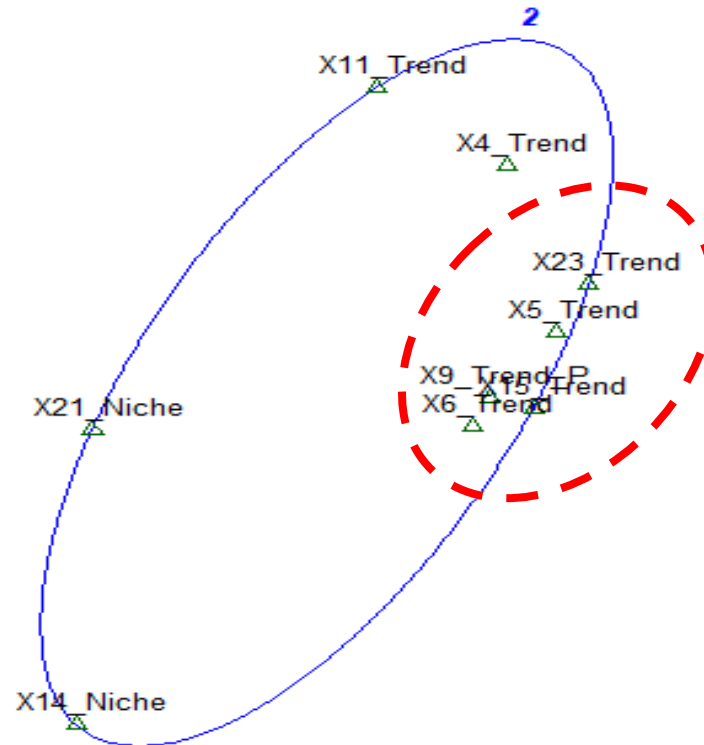
## Cluster Plot based on Dual Component Variance





## CASE STUDY 2 – Focusing in on managers

Diversification within the cluster



Cluster analysis can help with selecting a manager to truly complement incumbents

## CASE STUDY 3: IMPACT ON PORTFOLIO DIVERSIFICATION

Proposed Portfolio

Asset Class	Proposed SAA
Australian Equities	25.0%
International Equities	35.0%
Credit	10.0%
Fixed Income	15.0%
Alternatives	10.0%
Cash	5.0%

**How close does my portfolio represent my asset class beta objectives...?**

NOTE: This Proposed SAA is for demonstration purposes ONLY and should not be considered a Portfolio Construction view of Frontier

# CLUSTER ANALYSIS – Try finding relationships in these 378 correlations!

Correlation Matrix of 22 Managers + 6 Index Returns

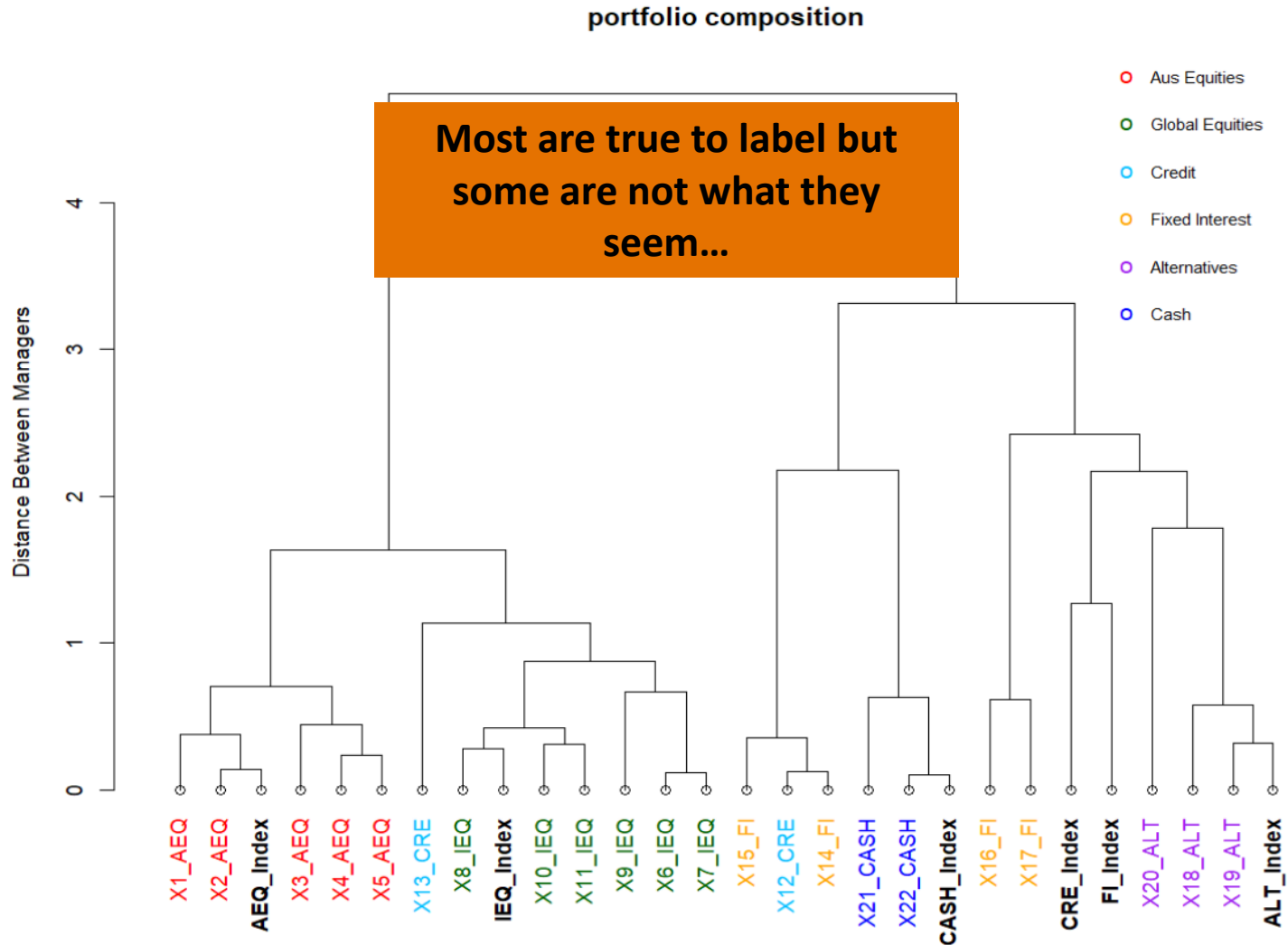
	1_AEQ	2_AEQ	3_AEQ	4_AEQ	5_AEQ	6_IEQ	7_IEQ	8_IEQ	9_IEQ	10_IEQ	11_IEQ	12_CRE	13_CRE	14_FI	15_FI	16_FI	17_FI	18_ALT	19_ALT	20_ALT	21_CASH	22_CASH	AEQ_Ind	IEQ_Ind	CRE_Ind	FI_Index	ALT_Ind	CASH_In
1_AEQ	100%																											
2_AEQ	91%	100%																										
3_AEQ	82%	78%	100%																									
4_AEQ	78%	83%	81%	100%																								
5_AEQ	71%	78%	77%	91%	100%																							
6_IEQ	48%	57%	54%	64%	62%	100%																						
7_IEQ	49%	58%	52%	64%	61%	97%	100%																					
8_IEQ	63%	70%	60%	70%	68%	83%	83%	100%																				
9_IEQ	59%	66%	53%	65%	59%	81%	81%	88%	100%																			
10_IEQ	59%	62%	54%	59%	57%	77%	77%	89%	86%	100%																		
11_IEQ	64%	72%	60%	71%	68%	83%	83%	96%	91%	92%	100%																	
12_CRE	-9%	-15%	-12%	-20%	-22%	-32%	-34%	-38%	-21%	-28%	-31%	100%																
13_CRE	42%	47%	52%	51%	50%	57%	54%	68%	48%	58%	63%	-26%	100%															
14_FI	-8%	-15%	-9%	-16%	-20%	-33%	-35%	-38%	-19%	-27%	-30%	97%	-26%	100%														
15_FI	-14%	-19%	-19%	-23%	-27%	-40%	-41%	-44%	-25%	-35%	-36%	95%	-33%	96%	100%													
16_FI	20%	24%	16%	26%	25%	68%	68%	43%	53%	53%	49%	3%	21%	1%	-4%	100%												
17_FI	7%	14%	8%	18%	16%	53%	53%	29%	39%	36%	36%	18%	11%	16%	10%	88%	100%											
18_ALT	6%	10%	4%	5%	3%	1%	3%	-5%	15%	7%	6%	29%	-22%	33%	36%	19%	23%	100%										
19_ALT	12%	14%	10%	10%	7%	2%	6%	6%	20%	14%	16%	28%	-12%	30%	35%	17%	15%	73%	100%									
20_ALT	10%	9%	14%	12%	11%	8%	10%	7%	13%	12%	8%	5%	-6%	6%	5%	14%	9%	25%	17%	100%								
21_CASH	7%	0%	8%	2%	12%	10%	5%	7%	8%	11%	4%	26%	11%	27%	20%	17%	8%	8%	3%	25%	100%							
22_CASH	-3%	-9%	-7%	-8%	-1%	-2%	-6%	-4%	0%	1%	-5%	26%	-2%	25%	21%	12%	10%	2%	2%	19%	80%	100%						
AEQ_Index	95%	97%	82%	84%	78%	58%	59%	68%	63%	61%	69%	-15%	48%	-15%	-19%	27%	17%	7%	10%	12%	2%	-9%	100%					
IEQ_Index	70%	74%	63%	71%	66%	77%	77%	96%	87%	91%	95%	-36%	64%	-35%	-40%	35%	17%	3%	13%	6%	5%	-7%	72%	100%				
CRE_Index	24%	23%	19%	24%	18%	35%	35%	18%	30%	23%	25%	46%	22%	46%	41%	59%	62%	37%	30%	4%	18%	8%	26%	17%	100%			
FI_Index	0%	-2%	-6%	-3%	-9%	0%	1%	-20%	1%	-9%	-9%	66%	-16%	66%	65%	40%	51%	48%	37%	2%	7%	7%	0%	-18%	87%	100%		
ALT_Index	11%	9%	7%	7%	3%	4%	7%	2%	18%	11%	14%	32%	-12%	35%	37%	17%	18%	79%	89%	23%	8%	2%	6%	11%	39%	47%	100%	
CASH_Index	0%	-7%	-5%	-6%	0%	-2%	-5%	-4%	0%	0%	-5%	29%	-1%	28%	24%	11%	10%	1%	3%	20%	80%	99%	-6%	-6%	9%	9%	2%	100%

How can you determine manager weights based on this matrix?

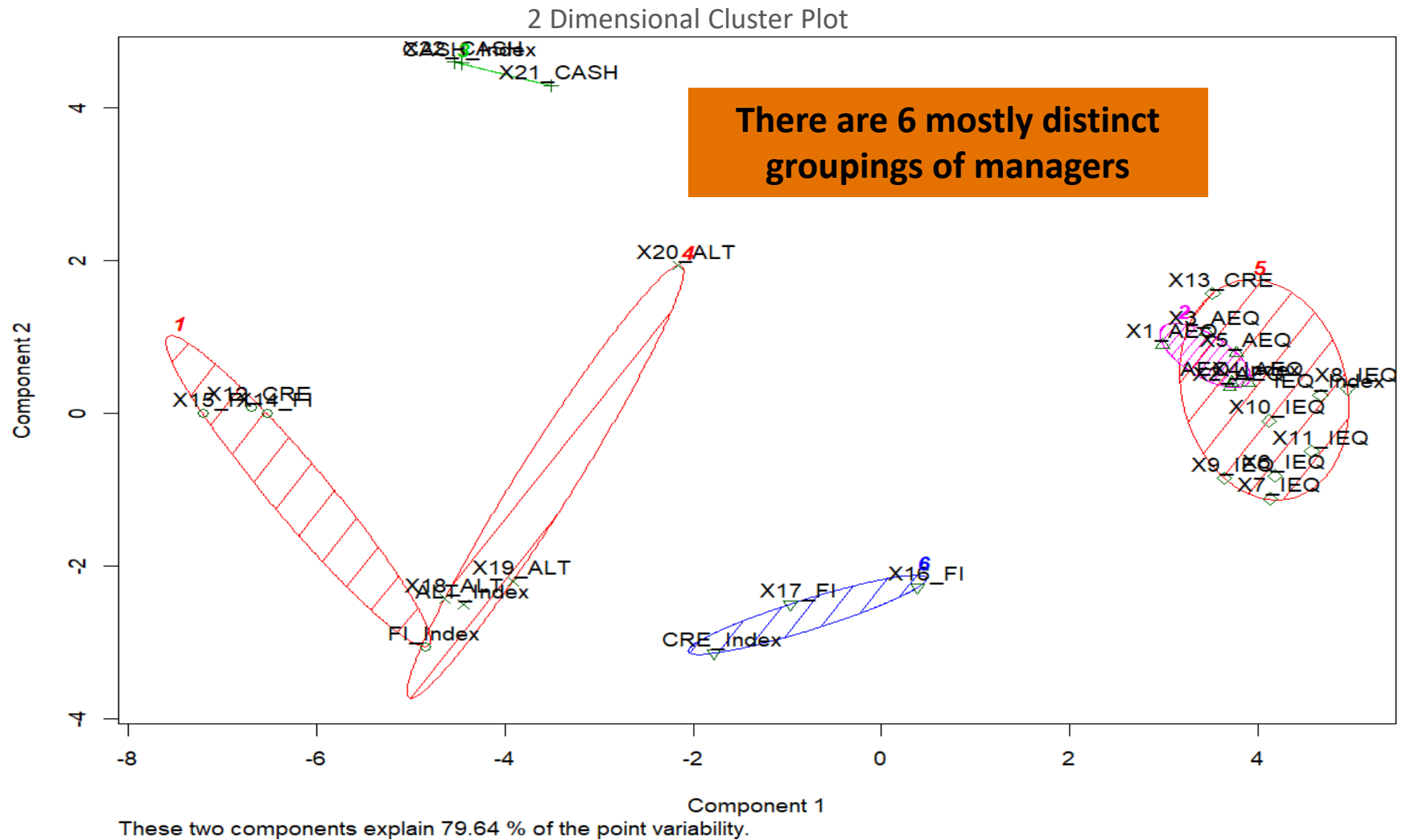
How can you determine manager weights based on this matrix?

Source (slides 22-26): Frontier, Bloomberg. Correlation data is based on time series returns for the period 2011 to 2019

# PORTFOLIO CONSTRUCTION



# PORTFOLIO CONSTRUCTION – A DIFFERENT VIEW



# IMPACT ON PORTFOLIO DIVERSIFICATION

## Impact to Proposed SAA

Asset Class	Proposed SAA	Actual SAA	Difference
Australian Equities	25.0%	25.0%	0.0%
International Equities	35.0%	40.0%	5.0%
Credit	10.0%	7.5%	-2.5%
Fixed Income	15.0%	12.5%	-2.5%
Alternatives	10.0%	10.0%	0.0%
Cash	5.0%	5.0%	0.0%
1 Year Return	4.0%	3.9%	-0.1%
1 Year Risk	15.0%	15.7%	0.7%
3 Year Return	5.4%	5.5%	0.1%
3 Year Risk	10.0%	10.4%	0.4%
5 Year Return	4.8%	5.1%	0.3%
5 Year Risk	8.9%	9.3%	0.4%

Source (for slides 24-28): Frontier, Managers. Data 2011 to 2019 with correlation calculated with MSCI World Total Return Index

**Portfolio is running more risk than expected**



# PORTFOLIO SUMMARY

## Impact to Actual Portfolio Returns

Asset Class	Asset Class Allocation	Cluster Allocation	Difference
Australian Equities	25.0%	25.0%	0.0%
International Equities	35.0%	35.0%	0.0%
Credit	10.0%	10.0%	0.0%
Fixed Income	15.0%	15.0%	0.0%
Alternatives	10.0%	10.0%	0.0%
Cash	5.0%	5.0%	0.0%
1 Year Return	1.9%	3.9%	2.0%
1 Year Risk	15.8%	14.6%	-1.2%
3 Year Return	4.6%	4.7%	0.1%
3 Year Risk	10.2%	9.6%	-0.7%
5 Year Return	4.9%	5.0%	0.1%
5 Year Risk	9.0%	8.4%	-0.6%

**Taking clusters into account for manager weights can improve returns and/or reduce risk**

# HOW IS FRONTIER USING THIS: Within the Alternatives Team

**To better understand sub-sector configuration**

**Reviewing how true to label manager products are**

**Assessing diversification benefits of new strategies being added to an existing portfolio**

# KEY TAKEAWAYS FOR CLUSTERING



## It's smarter

- machine based learning
- It does look at past data, and is complementary to fundamental and forward looking analysis



## Examines Relationships

- contemplates a wider range of explanatory relationships than typically assumed in portfolio construction or asset allocation



## Presents Opportunities

- Are investments “True to Label”
- Hidden beta
- Deepen understanding in different market conditions
- Different portfolio designs
- Deliver superior outcomes

**How can Frontier help you leverage this powerful tool in your portfolio?**

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