***Calculation Example***

Q1) Find the discrete yearly returns of stocks CBA and BHP from the following price data.

|  |  |
| --- | --- |
| **Date** | **Adjusted Closing Price ($)** |
| **CBA** | **BHP** |
| 1/1/2007 | 48.39 | 25.17 |
| 2/1/2008 | 47.77 | 36.31 |
| 2/1/2009 | 26.01 | 30.11 |
| 4/1/2010 | 51.47 | 38.9 |
| 4/1/2011 | 52.46 | 44.25 |
|  |  |  |

To find CBA’s return from 2010 to 2011,

$$r\_{CBA, 2010\rightarrow 2011}=\frac{p\_{4/1/2011}}{p\_{4/1/2010}}-1$$

$$ =\frac{52.46}{51.47}-1=0.0192$$

And so on. Here are the complete results:

|  |  |
| --- | --- |
| **Date** | **Return (p.a.)** |
| **CBA** | **BHP** |
| 1/1/2007 |  |  |
| 2/1/2008 | -0.0128 | 0.4426 |
| 2/1/2009 | -0.4555 | -0.1708 |
| 4/1/2010 | 0.9789 | 0.2919 |
| 4/1/2011 | 0.0192 | 0.1375 |
|  |  |   |

Q2) Calculate the arithmetic mean, variance and standard deviation of returns.

$$\overbar{r}\_{\begin{array}{c}CBA,\\ 2007\rightarrow \\2011,pa\end{array}}=\frac{r\_{CBA,07\rightarrow 08}+r\_{CBA,08\rightarrow 09}+r\_{CBA,09\rightarrow 10}+r\_{CBA,10\rightarrow 11}}{n}$$

$$ =\frac{-0.0128-0.4555+0.9789+0.0192}{4} =0.1324$$

$$var\left(r\right)=σ^{2}=\frac{\sum\_{i=1}^{n}\left[\left(r\_{i}-\overbar{r}\right)^{2}\right]}{n-1}$$

$$σ\_{CBA, 2007\rightarrow 2011,p.a.}^{2}=\frac{\left[\begin{array}{c}\left(-0.0128-0.1324\right)^{2}+\\\left(-0.4555-0.1324\right)^{2}+\\\left(0.9789-0.1324\right)^{2}+\\\left(0.0192-0.1324\right)^{2}\end{array}\right]}{4-1}=0.3653 $$

$$σ\_{CBA, 2007\rightarrow 2011,p.a.}^{2}=0.3653$$

$$σ\_{CBA, 2007\rightarrow 2011,p.a.}=\sqrt{0.3653}$$

$$ =0.6044$$

Similarly for BHP. Here are the complete results:

|  |  |  |
| --- | --- | --- |
|  | **CBA** | **BHP** |
| **Return** | 0.1324 | 0.1753 |
| **Variance** | 0.3653 | 0.0687 |
| **St. dev.** | 0.6044 | 0.2622 |
|   |   |   |

Q3) Calculate the covariance and correlation of their returns.

$$cov\left(r\_{A}, r\_{B}\right)=σ\_{A,B}=\frac{\sum\_{i=1}^{n}\left[\left(r\_{A,i}-\overbar{r}\_{A}\right)\left(r\_{B,i}-\overbar{r}\_{B}\right)\right]}{n-1}$$

$$σ\_{CBA,BHP, 2007\rightarrow 2011,p.a.}=$$

$$ \frac{\left[\begin{array}{c}\left(-0.0128-0.1324\right)×\left(0.4426-0.1753\right)+\\\left(-0.4555-0.1324\right)×\left(-0.1708-0.1753\right)+\\\left(0.9789-0.1324\right)×\left(0.2919-0.1753\right)+\\\left(0.0192-0.1324\right)×\left(0.1375-0.1753\right)+\end{array}\right]}{4-1} $$

$$σ\_{CBA,BHP, 2007\rightarrow 2011,p.a.}=0.0892$$

$$correl\left(r\_{1}, r\_{2}\right)=ρ\_{1,2}=\frac{cov\left(r\_{1}, r\_{2}\right)}{sd\left(r\_{1}\right).sd\left(r\_{2}\right)}=\frac{σ\_{1,2}}{σ\_{1}.σ\_{2}}$$

$$ρ\_{CBA,BHP, 2007-2011,p.a.}=\frac{0.0892}{0.6044×0.2622}$$

$$ =0.5629$$

|  |  |  |
| --- | --- | --- |
|  | **CBA** | **BHP** |
| **Covariance** | 0.0892 |
| **Correlation** | 0.5629 |
|   |   |   |

In conclusion, BHP has a higher return and lower risk than CBA. The correlation is not near one so a fair amount of diversification is possible.