

DATA

Period	All Property (%)	Office (%)	Retail (%)	Industrial (%)	T-bills (%)
31 12 1995	14.60	14.13	16.94	12.56	13.94
31 12 1996	14.09	9.97	17.36	18.98	15.93
31 12 1997	16.78	12.45	21.76	15.63	14.65
31 12 1998	5.45	2.08	9.52	2.77	17.2
31 12 1999	13.02	10.13	16.74	8.36	10.7
31 12 2000	11.16	13.18	10.60	6.86	10.2
31 12 2001	10.25	6.59	13.93	7.86	9.2
31 12 2002	9.10	4.71	11.22	9.73	12.27
31 12 2003	14.89	8.94	17.37	18.16	7.31
31 12 2004	22.52	17.01	25.31	23.31	7.27
31 12 2005	30.02	25.94	32.24	32.30	6.82
31 12 2006	26.77	25.40	27.26	30.25	8.39
31 12 2007	27.27	26.62	24.85	31.18	10.48
31 12 2008	12.69	15.02	10.75	18.81	10.77
31 12 2009	8.27	8.25	9.88	7.80	7.07
31 12 2010	13.60	13.51	13.93	13.80	5.59
31 12 2011	10.90	9.92	11.23	12.60	5.46
31 12 2012	14.38	12.40	15.68	15.72	4.99
31 12 2013	15.66	13.11	17.27	17.49	5.14
31 12 2014	12.67	12.61	12.82	13.13	6.04
31 12 2015	12.61	11.86	13.11	13.29	6.74
31 12 2016	10.99	7.63	12.45	13.15	7.61
31 12 2017	10.96	10.49	11.26	12.43	7.53

Period	Question 2a and 2b									
	All Property	Office	Retail	Industrial	T-bills	All Property	Office	Retail	Industrial	T-bills
31 12 1995	14.60	14.13	16.94	12.56	13.94	1.1459783	1.1413483	1.1693822	1.1256264	1.1394
31 12 1996	14.09	9.97	17.36	18.98	15.93	1.140924	1.0997101	1.1735872	1.1898348	1.1593
31 12 1997	16.78	12.45	21.76	15.63	14.65	1.1677746	1.1245032	1.2175505	1.1563135	1.1465
31 12 1998	5.45	2.08	9.52	2.77	17.20	1.0545479	1.0207591	1.0951635	1.0277495	1.172
31 12 1999	13.02	10.13	16.74	8.36	10.70	1.1301751	1.1012993	1.1673792	1.0835761	1.107
31 12 2000	11.16	13.18	10.60	6.86	10.20	1.1116343	1.1318277	1.1060421	1.0685831	1.102
31 12 2001	10.25	6.59	13.93	7.86	9.20	1.1024711	1.065923	1.13926	1.0785826	1.092
31 12 2002	9.10	4.71	11.22	9.73	12.27	1.0909664	1.0470885	1.1121701	1.0973291	1.1227
31 12 2003	14.89	8.94	17.37	18.16	7.31	1.1489392	1.0894027	1.1737044	1.1816455	1.0731
31 12 2004	22.52	17.01	25.31	23.31	7.27	1.2252012	1.1701462	1.253112	1.2331481	1.0727
31 12 2005	30.02	25.94	32.24	32.30	6.82	1.3002061	1.2593991	1.3224024	1.3229595	1.0682
31 12 2006	26.77	25.40	27.26	30.25	8.39	1.2676917	1.2539981	1.2726128	1.3024856	1.0839
31 12 2007	27.27	26.62	24.85	31.18	10.48	1.2727133	1.2662463	1.2484962	1.3117702	1.1048
31 12 2008	12.69	15.02	10.75	18.81	10.77	1.1269268	1.1502456	1.107528	1.1881189	1.1077
31 12 2009	8.27	8.25	9.88	7.80	7.07	1.0827471	1.0825377	1.098846	1.0779752	1.0707
31 12 2010	13.60	13.51	13.93	13.80	5.59	1.1360201	1.1351391	1.1393364	1.1379697	1.0559
31 12 2011	10.90	9.92	11.23	12.60	5.46	1.109042	1.0991639	1.1123354	1.1259726	1.0546
31 12 2012	14.38	12.40	15.68	15.72	4.99	1.1437792	1.1239785	1.1568321	1.1571584	1.0499
31 12 2013	15.66	13.11	17.27	17.49	5.14	1.1565837	1.1310946	1.1726801	1.174931	1.0514
31 12 2014	12.67	12.61	12.82	13.13	6.04	1.1266527	1.126141	1.128213	1.1312861	1.0604
31 12 2015	12.61	11.86	13.11	13.29	6.74	1.1261443	1.1185599	1.1310622	1.1329008	1.0674
31 12 2016	10.99	7.63	12.45	13.15	7.61	1.1099264	1.076316	1.124525	1.1315333	1.0761
31 12 2017	10.96	10.49	11.26	12.43	7.53	1.1095724	1.1049113	1.1126066	1.1242551	1.0753

$\sum \text{HPY}$	338.6618	291.9739	373.4827	356.1705	211.3000
n	23.0000	23.0000	23.0000	23.0000	23.0000
$\text{AM} = \sum \text{HPY}/n$	14.7244	12.6945	16.2384	15.4857	9.1870
AM using Excel	14.7244	12.6945	16.2384	15.4857	9.1870
$\prod \text{HPR}$	22.8305	15.1183	30.9050	26.1343	7.4633
$\text{GM} = (\prod \text{HPR})^{1/n} - 1$	14.5687	12.5337	16.0871	15.2439	9.1323
GM using Excel	14.5687	12.5337	16.0871	15.2439	9.1323
Sample Standard Deviation	6.232349	6.247898	6.171864	7.759812	3.560984

QUESTION (20 MARKS)

Below is a link to a spreadsheet containing the total returns of South African direct property between 1995 and 2017. The return on Treasury Bills has also been provided.

[INSERT LINK]

Calculate the sample geometric and arithmetic mean of all the return series given.

(5)

Calculate the sample standard deviation of the return series given. You may calculate this manually or using MS Excel.

(3)

Assuming the returns are normally distributed, calculate the probability that the return for the various sectors (office, retail and industrial) would exceed the return of the All-Property portfolio return.

(6)

Again, assuming the returns are normally distributed, calculate the probability that the return for the various sectors (office, retail and industrial) would exceed the yield on T-bills in 2018.

(6)

Question 2c

Period	All Property	Office	Retail	Industrial	T-bills	All Property	Office	Retail	Industrial	T-bills
31 12 1995	14.60	14.13	16.94	12.56	13.94	1.1459783	1.1413483	1.1693822	1.1256264	1.1394
31 12 1996	14.09	9.97	17.36	18.98	15.93	1.140924	1.0997101	1.1735872	1.1898348	1.1593
31 12 1997	16.78	12.45	21.76	15.63	14.65	1.1677746	1.1245032	1.2175505	1.1563135	1.1465
31 12 1998	5.45	2.08	9.52	2.77	17.20	1.0545479	1.0207591	1.0951635	1.0277495	1.172
31 12 1999	13.02	10.13	16.74	8.36	10.70	1.1301751	1.1012993	1.1673792	1.0835761	1.107
31 12 2000	11.16	13.18	10.60	6.86	10.20	1.1116343	1.1318277	1.1060421	1.0685831	1.102
31 12 2001	10.25	6.59	13.93	7.86	9.20	1.1024711	1.065923	1.13926	1.0785826	1.092
31 12 2002	9.10	4.71	11.22	9.73	12.27	1.0909664	1.0470885	1.1121701	1.0973291	1.1227
31 12 2003	14.89	8.94	17.37	18.16	7.31	1.1489392	1.0894027	1.1737044	1.1816455	1.0731
31 12 2004	22.52	17.01	25.31	23.31	7.27	1.2252012	1.1701462	1.253112	1.2331481	1.0727
31 12 2005	30.02	25.94	32.24	32.30	6.82	1.3002061	1.2593991	1.3224024	1.3229595	1.0682
31 12 2006	26.77	25.40	27.26	30.25	8.39	1.2676917	1.2539981	1.2726128	1.3024856	1.0839
31 12 2007	27.27	26.62	24.85	31.18	10.48	1.2727133	1.2662463	1.2484962	1.3117702	1.1048
31 12 2008	12.69	15.02	10.75	18.81	10.77	1.1269268	1.1502456	1.107528	1.1881189	1.1077
31 12 2009	8.27	8.25	9.88	7.80	7.07	1.0827471	1.0825377	1.098846	1.0779752	1.0707
31 12 2010	13.60	13.51	13.93	13.80	5.59	1.1360201	1.1351391	1.1393364	1.1379697	1.0559
31 12 2011	10.90	9.92	11.23	12.60	5.46	1.109042	1.0991639	1.1123354	1.1259726	1.0546
31 12 2012	14.38	12.40	15.68	15.72	4.99	1.1437792	1.1239785	1.1568321	1.1571584	1.0499
31 12 2013	15.66	13.11	17.27	17.49	5.14	1.1565837	1.1310946	1.1726801	1.174931	1.0514
31 12 2014	12.67	12.61	12.82	13.13	6.04	1.1266527	1.126141	1.128213	1.1312861	1.0604
31 12 2015	12.61	11.86	13.11	13.29	6.74	1.1261443	1.1185599	1.1310622	1.1329008	1.0674
31 12 2016	10.99	7.63	12.45	13.15	7.61	1.1099264	1.076316	1.124525	1.1315333	1.0761
31 12 2017	10.96	10.49	11.26	12.43	7.53	1.1095724	1.1049113	1.1126066	1.1242551	1.0753

Average Return	14.724426	12.694518	16.238380	15.485674	9.186957
Sample Standard Deviation	6.232349	6.247898	6.171864	7.759812	3.560984

Probability that Returns are greater than All Property

Target Return - All Property **14.724426**

Office

Average Return	12.694518
Standard Deviation	6.247898
Z-score	0.3249
P(Z<A)	0.6274
P(Z>A)	0.3726

Retail

Average Return	16.238380
Standard Deviation	6.171864
Z-score	-0.245299354
P(Z<A)	0.4031
P(Z>A)	0.5969

Industrial

Average Return	15.485674
Standard Deviation	7.759812
Z-score	-0.098101441
P(Z<A)	0.4609
P(Z>A)	0.5391

Question 2d

Period	All Property	Office	Retail	Industrial	T-bills	All Property	Office	Retail	Industrial	T-bills
31 12 1995	14.60	14.13	16.94	12.56	13.94	1.1459783	1.1413483	1.1693822	1.1256264	1.1394
31 12 1996	14.09	9.97	17.36	18.98	15.93	1.140924	1.0997101	1.1735872	1.1898348	1.1593
31 12 1997	16.78	12.45	21.76	15.63	14.65	1.1677746	1.1245032	1.2175505	1.1563135	1.1465
31 12 1998	5.45	2.08	9.52	2.77	17.20	1.0545479	1.0207591	1.0951635	1.0277495	1.172
31 12 1999	13.02	10.13	16.74	8.36	10.70	1.1301751	1.1012993	1.1673792	1.0835761	1.107
31 12 2000	11.16	13.18	10.60	6.86	10.20	1.1116343	1.1318277	1.1060421	1.0685831	1.102
31 12 2001	10.25	6.59	13.93	7.86	9.20	1.1024711	1.065923	1.13926	1.0785826	1.092
31 12 2002	9.10	4.71	11.22	9.73	12.27	1.0909664	1.0470885	1.1121701	1.0973291	1.1227
31 12 2003	14.89	8.94	17.37	18.16	7.31	1.1489392	1.0894027	1.1737044	1.1816455	1.0731
31 12 2004	22.52	17.01	25.31	23.31	7.27	1.2252012	1.1701462	1.253112	1.2331481	1.0727
31 12 2005	30.02	25.94	32.24	32.30	6.82	1.3002061	1.2593991	1.3224024	1.3229595	1.0682
31 12 2006	26.77	25.40	27.26	30.25	8.39	1.2676917	1.2539981	1.2726128	1.3024856	1.0839
31 12 2007	27.27	26.62	24.85	31.18	10.48	1.2727133	1.2662463	1.2484962	1.3117702	1.1048
31 12 2008	12.69	15.02	10.75	18.81	10.77	1.1269268	1.1502456	1.107528	1.1881189	1.1077
31 12 2009	8.27	8.25	9.88	7.80	7.07	1.0827471	1.0825377	1.098846	1.0779752	1.0707
31 12 2010	13.60	13.51	13.93	13.80	5.59	1.1360201	1.1351391	1.1393364	1.1379697	1.0559
31 12 2011	10.90	9.92	11.23	12.60	5.46	1.109042	1.0991639	1.1123354	1.1259726	1.0546
31 12 2012	14.38	12.40	15.68	15.72	4.99	1.1437792	1.1239785	1.1568321	1.1571584	1.0499
31 12 2013	15.66	13.11	17.27	17.49	5.14	1.1565837	1.1310946	1.1726801	1.174931	1.0514
31 12 2014	12.67	12.61	12.82	13.13	6.04	1.1266527	1.126141	1.128213	1.1312861	1.0604
31 12 2015	12.61	11.86	13.11	13.29	6.74	1.1261443	1.1185599	1.1310622	1.1329008	1.0674
31 12 2016	10.99	7.63	12.45	13.15	7.61	1.1099264	1.076316	1.124525	1.1315333	1.0761
31 12 2017	10.96	10.49	11.26	12.43	7.53	1.1095724	1.1049113	1.1126066	1.1242551	1.0753
Average Return	14.724426	12.694518	16.238380	15.485674	9.186957					
Sample Standard Deviation	6.232349	6.247898	6.171864	7.759812	3.560984					

Probability that Returns are greater than T-bills

Target Return - T-bills 9.186957

Office

Average Return	12.694518
Standard Deviation	6.247898
Z-score	-0.5614
P(Z<A)	0.2873
P(Z>A)	0.7127

Retail

Average Return	16.238380
Standard Deviation	6.171864
Z-score	-1.142511083
P(Z<A)	0.1266
P(Z>A)	0.8734

Industrial

Average Return	15.485674
Standard Deviation	7.759812
Z-score	-0.811710157
P(Z<A)	0.2085
P(Z>A)	0.7915

Question 3

										Price						Value-		Price Return 2			
					Sum of Stock		Weighted	Price Return						Sum of Market		weighted	Price Return 1	(Value-			
					Prices	Divisor	Index	1	2					Values	Divisor	index	(Value-Weighted)	Weighted)			
Date	Stock Prices		No. of shares outstanding																		
	Delta	Equites	Delta	Equites							Delta	Equites									
01 01 2015	8.70	11.00	458410.00	114410.00	19.70	0.20	100.00				3988167.00	1258510.00	5246677.00	52466.77	100.00						
01 02 2015	9.25	11.25	458410.00	114410.00	20.50	0.20	104.06	4.06	4.06		4240292.50	1287112.50	5527405.25	52466.77	105.35	5.35	5.35				
01 03 2015	9.05	12.70	533097.00	279862.00	21.75	0.20	110.41	6.10	6.10		4824527.85	3554247.40	8378775.25	52466.77	159.70	51.59	51.59				
01 04 2015	8.99	12.50	533097.00	279862.00	21.49	0.20	109.09	-1.20	-1.20		4792542.03	3498275.00	8290817.03	52466.77	158.02	-1.05	-1.05				
01 05 2015	9.40	12.74	533097.00	279862.00	22.14	0.20	112.39	3.02	3.02		5011111.80	3565441.88	8576553.68	52466.77	163.47	3.45	3.45				
01 06 2015	8.90	12.14	533097.00	279862.00	21.04	0.20	106.80	-4.97	-4.97		4744563.30	3397524.68	8142087.98	52466.77	155.19	-5.07	-5.07				
01 07 2015	8.16	12.00	533097.00	279862.00	20.16	0.20	102.34	-4.18	-4.18		4350071.52	3358344.00	7708415.52	52466.77	146.92	-5.33	-5.33				
01 08 2015	8.10	11.90	533097.00	279862.00	20.00	0.20	101.52	-0.79	-0.79		4318085.70	3330357.80	7648443.50	52466.77	145.78	-0.78	-0.78				
01 09 2015	8.20	12.30	533097.00	279862.00	20.50	0.20	104.06	2.50	2.50		4371395.40	3442302.60	7813698.00	52466.77	148.93	2.16	2.16				
01 10 2015	7.99	11.71	533097.00	279862.00	19.70	0.20	100.00	-3.90	-3.90		4259445.03	3277184.02	7536629.05	52466.77	143.65	-3.55	-3.55				
01 11 2015	8.35	12.95	533097.00	279862.00	21.30	0.20	108.12	8.12	8.12		4451359.95	3624212.90	8075572.85	52466.77	153.92	7.15	7.15				
01 12 2015	7.35	14.25	533097.00	279862.00	21.60	0.20	109.64	1.41	1.41		3918262.95	3988033.50	7906296.45	52466.77	150.69	-2.10	-2.10				
01 01 2016	6.85	12.75	533097.00	279862.00	19.60	0.20	99.49	-9.26	-9.26		3651714.45	3568240.50	7219954.95	52466.77	137.61	-8.68	-8.68				
01 02 2016	6.45	12.45	533097.00	279862.00	18.90	0.20	95.94	-3.57	-3.57		3438475.65	3484281.90	6922757.55	52466.77	131.95	-4.12	-4.12				
01 03 2016	6.44	12.00	710632.00	350465.00	18.44	0.20	93.60	-2.43	-2.43		4576470.08	4205580.00	8782050.08	52466.77	167.38	26.86	26.86				
01 04 2016	6.50	12.20	710632.00	350465.00	18.70	0.20	94.92	1.41	1.41		4619108.00	4275673.00	8894781.00	52466.77	169.53	1.28	1.28				
01 05 2016	6.75	13.00	710632.00	350465.00	19.75	0.20	100.25	5.61	5.61		4796766.00	4556045.00	9352811.00	52466.77	178.26	5.15	5.15				
01 06 2016	7.24	13.50	710632.00	350465.00	20.74	0.20	105.28	5.01	5.01		5144975.68	4731277.50	9876253.18	52466.77	188.24	5.60	5.60				
01 07 2016	6.51	14.25	710632.00	350465.00	20.76	0.20	105.38	0.10	0.10		4626214.32	4994126.25	9620340.57	52466.77	183.36	-2.59	-2.59				
01 08 2016	6.70	14.50	710632.00	350465.00	21.20	0.20	107.61	2.12	2.12		4761234.40	5081742.50	9842976.90	52466.77	187.60	2.31	2.31				
01 09 2016	6.70	14.75	710632.00	350465.00	21.45	0.20	108.88	1.18	1.18		4761234.40	5169358.75	9930593.15	52466.77	189.27	0.89	0.89				
01 10 2016	7.70	14.60	710632.00	350465.00	22.30	0.20	113.20	3.96	3.96		5471866.40	5116789.00	10588655.40	52466.77	201.82	6.63	6.63				
01 11 2016	7.69	15.54	710632.00	350465.00	23.23	0.20	117.92	4.17	4.17		5464760.08	5446226.10	10910986.18	52466.77	207.96	3.04	3.04				
01 12 2016	7.72	14.65	710632.00	350465.00	22.37	0.20	113.55	-3.70	-3.70		5486079.04	5134312.25	10620391.29	52466.77	202.42	-2.66	-2.66				

