This assignment concerns investing in two assets: the US S&P 500 and the Japanese Nikkei index. The data file IntlInvest.jmp (on the class web page) has the monthly values for these two indices from January 1990 through February, 1999. The data file includes currency exchange rates between Yen and US dollars as well. We will do the analysis using "mark-to-market."

(1) Compute the returns of the two stock indices and perform an initial descriptive analysis.

(a) Divide the Nikkei index by the given Yen/$ to convert the index to dollars. The mean return on the Nikkei (in dollars) over this period is –0.35% (SD 8%)whereas the S&P gained about 1.3% per month (SD 4%). The S&P index has higher (positive) return and is also less volatile.

(b) Based on the excess return series…

i) I see no trend in the mean level, though you might say that the both series (Nikkei in particular) were more volatile at the start of this period than at the end (i.e., more variance at the start). A quality chart is a good device to get at this issue further.

ii) Although we can see the occasional outlier, the quantile plots track the diagonal very closely are are within the variability allowed under the normal model. (Note again that there is some evidence for a lack of constant variance in these returns.)

iii) As noted in "a" above, the S&P is doing much better on average. In excess returns, the S&P has averaged 0.9% per month whereas the Nikkei excess is –0.75% per month.

iv) The Nikkei excess returns are also more variable, with variance .0065 versus .0015 for the S&P. Since we invest based on the ratio of mean return to variance to maximize utility, the variance is an essential part of this calculation. High returns that are too volatile are not appealing (remember the red die from Assign 6).

(c) The "right" analysis is as we have done so far. We have to convert the Nikkei into $'s to take into account currency fluctuations. Of course, these days someone will sell you Nikkei shares directly, but somewhere along the way you will have to adjust for currency risk. Those stocks that trade on the Nikkei are valued in Yen, not $'s.

(2) Consider the relationship between the two series of dollar-valued excess returns.

(a) The correlation 0.38 is indeed *statistically* significant. This is not simply a matter of the size of the correlation, but rather of this size relative to sampling variation – could this correlation have emerged by chance when in fact the two "populations" are not correlated? No. That the observed correlation is statistically significant can be seen from the correlation output (just ask for the pairwise list and JMP will show p-values) or from a regression. Since the R^2 of a regression is just the square of the usual correlation, we can see from the regression slope (t=4.24) or F test that the relationship is significant.

(b) The scatterplot of Nikkei on S&P shows the effects of some very leveraged outliers (particularly August 1998, last summer's swoon in the US and world markets) and a large but not very leveraged outlier in October 1990 when the Nikkei returned much more than would be expected.

(c) The correlation is important since one has to take into account the bivariate movement of these indices when investing, rather than looking at each one separately. That is, we cannot decide how much to invest in the Nikkei without considering its relationship to the S&P, and vice versa. Were the two series uncorrelated, we could look at the two investments separately.

(3) Consider the situation of an investor in the US who can hold either the US S&P 500 or the Nikkei.

(a) If you regress the Nikkei on the S&P, you get the fit

$$\text{Excess Nikkei} = -0.015 + 0.8\ \text{Excess S\&P}$$

Then create the uncorrelated Nikkei returns by subtracting 0.8 Excess S&P from the Nikkei excess returns. For these two uncorrelated instruments, you get the following summary:

	Mean [ci]	Variance	Mean/Variance
Excess S&P	0.0090 [.0017, .0163]	.0015	6.00 [1.1, 10.9]
Uncorr Nikkei	-0.0147 [-.03, -.0005]	.0056	-2.63 [-5.4, -.1]

The ratio of mean to variance, were these population values, suggests investing 6 times your wealth (given our usual assumptions of utility and risk aversion) in the S&P and shorting the Nikkei (i.e., selling these to others) by about 2.5 times wealth. Since these are not population values, however, we have to be more careful. Note the wide confidence intervals for the means. Investing closer to factors of one or two times wealth in the S&P is within the allowed variation given this data.

(b) Reversing the procedure and using the dollar-valued Nikkei excess returns as the baseline, we obtain the regression

Excess S&P = 0.01 + 0.18 Excess Nikkei

so that we can construct an uncorrelated pair as Excess Nikkei and (Excess S&P – 0.18 Excess Nikkei). The analogous table to that in "a" is

	Mean [ci]	Variance	Mean/Variance
Excess Nikkei	-0.0075 [-.023, 0.0078]	.0065	1.15 [-3.5, 1.2]
Uncorr S&P	0.0104 [.0036, .017]	.0013	8.00 [2.8, 13.1]

Since the CI for the mean excess return on the Nikkei includes zero, you probably want to avoid this one. For the S&P, you nominally want about seven to eight times your wealth here, but again sampling variation leads to a very wide range.

(c) All we are doing in this regression procedure is "dodging" the correlation by constructing two uncorrelated investments. It should not matter how we do this. We will start with "a", ignoring the wide sampling variation and using the point estimates. When we look at what we actually buy to construct these investments, we end up with

6 S&P – 2.63 (Uncorr Nikkei) = 6 S&P – 2.63(Nikkei – 0.8 S&P) = 8.1 S&P – 2.6 Nikkei.

Using the results of "b" and again using just the point estimates, as wild as they may be, we get essentially the same portfolio, owning about 8 times wealth in S&P and shorting the Nikkei by about a factor of 2.6,

-1.15 Nikkei + 8 (Uncorr S&P) = -1.15 Nikkei + 8 (S&P – 0.18 Nikkei) = 8 S&P – 2.6 Nikkei

(4) To repeat this analysis using the perspective of a Japanese investor, we would need to know the risk-free rate in Japan in order to compute the excess returns. I had hoped to find these, but have not.