Review of Probability Theory

AMATH 462/ECON 424
Sunmer 2012
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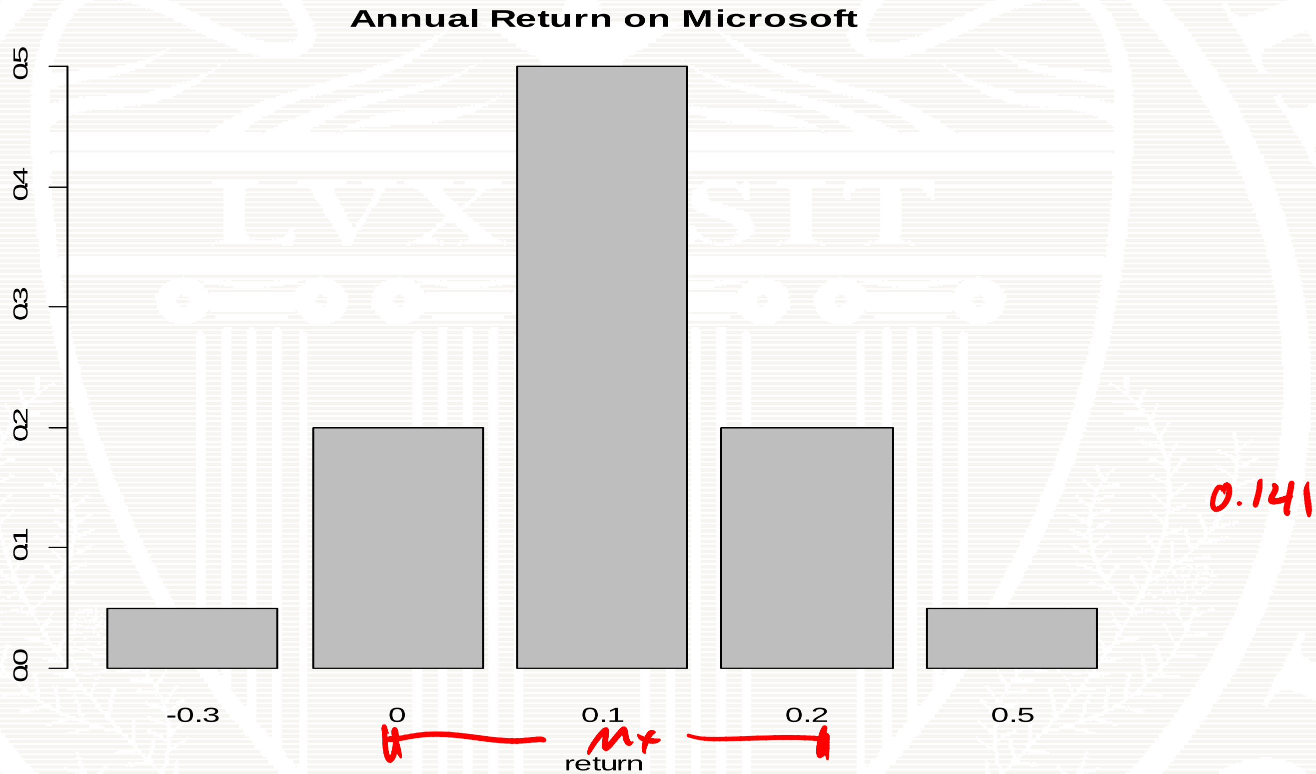
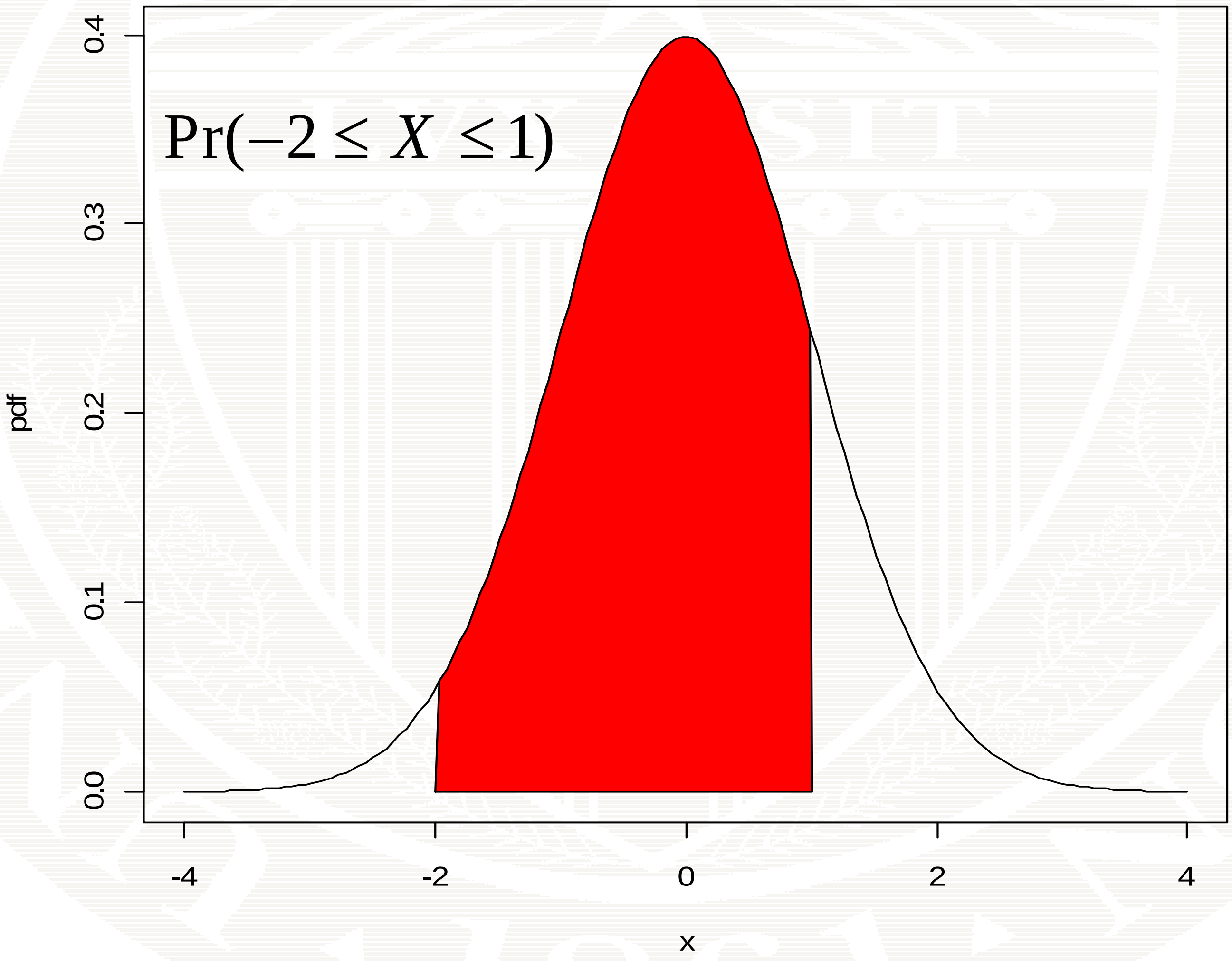
Updated: July 9, 2013

Discrete Distribution



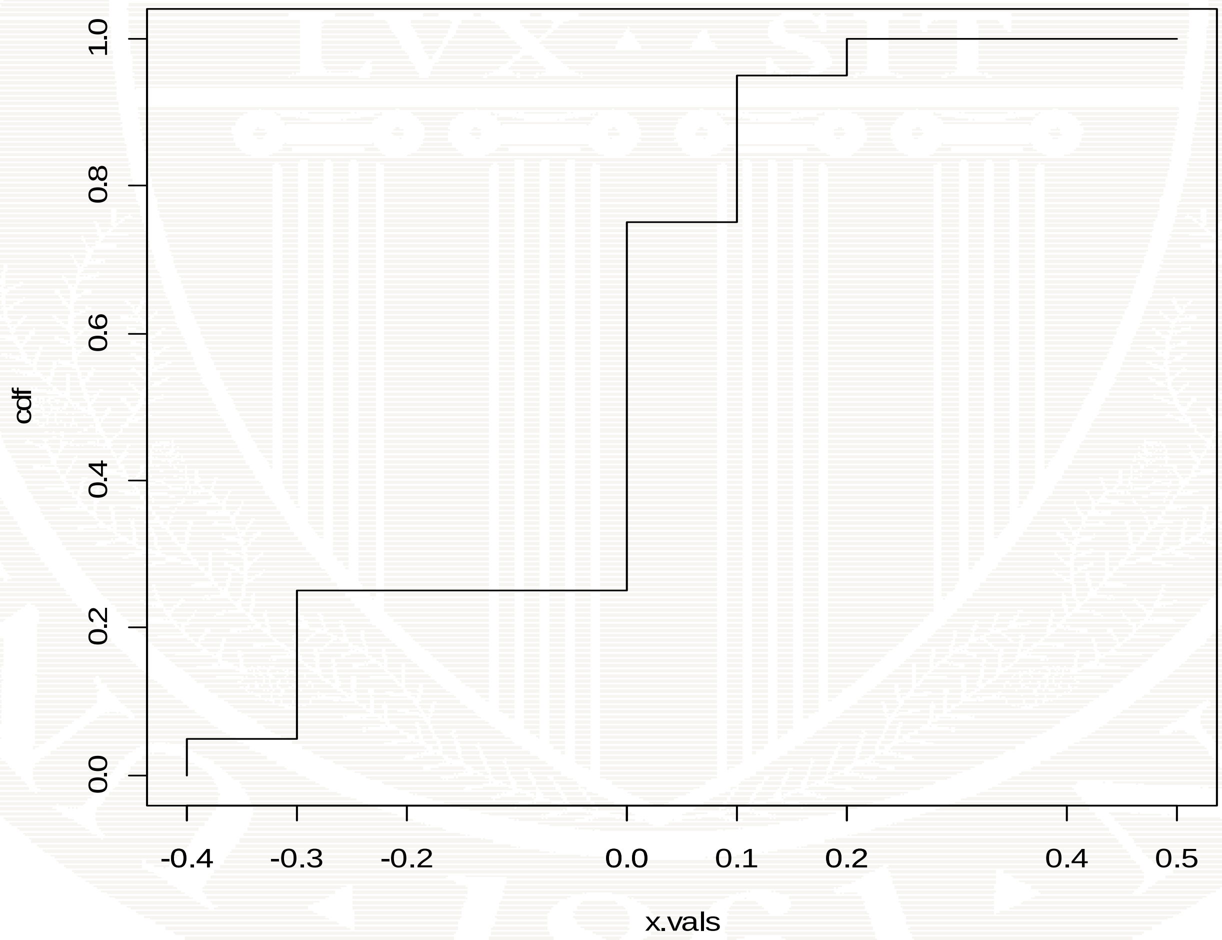

```
> r.msft = c(-0.3, 0, 0.1, 0.2, 0.5)
> prob.vals = c(0.05, 0.20, 0.50, 0.20, 0.05)
> barplot(prob.vals, names.arg = as.character(r.msft),
+         xlab="return")
> title("Annual Return on Microsoft")
```

Probability Curve for Continuous RV

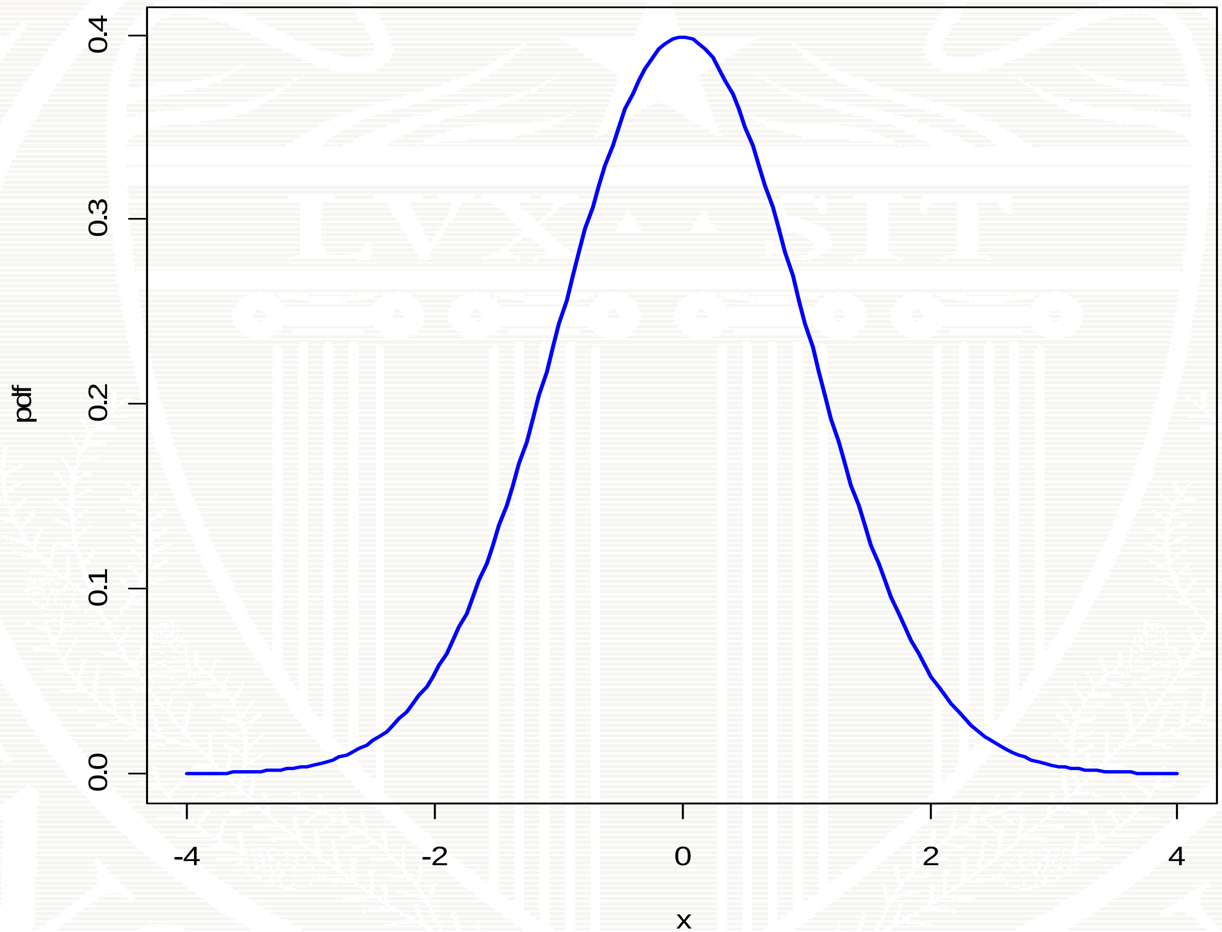


CDF of Discrete Distribution

$$F_X(x) = \Pr(X \leq x)$$

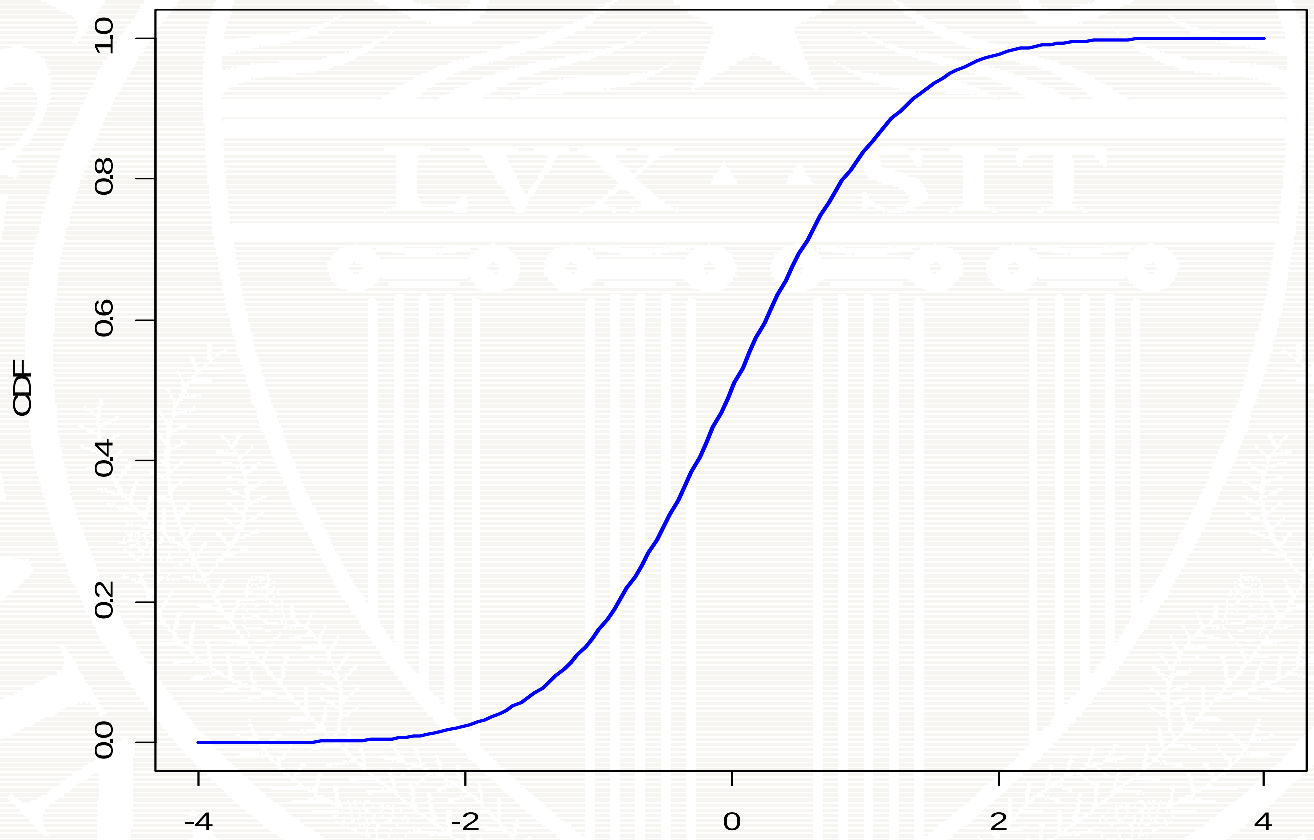


Standard Normal Distribution



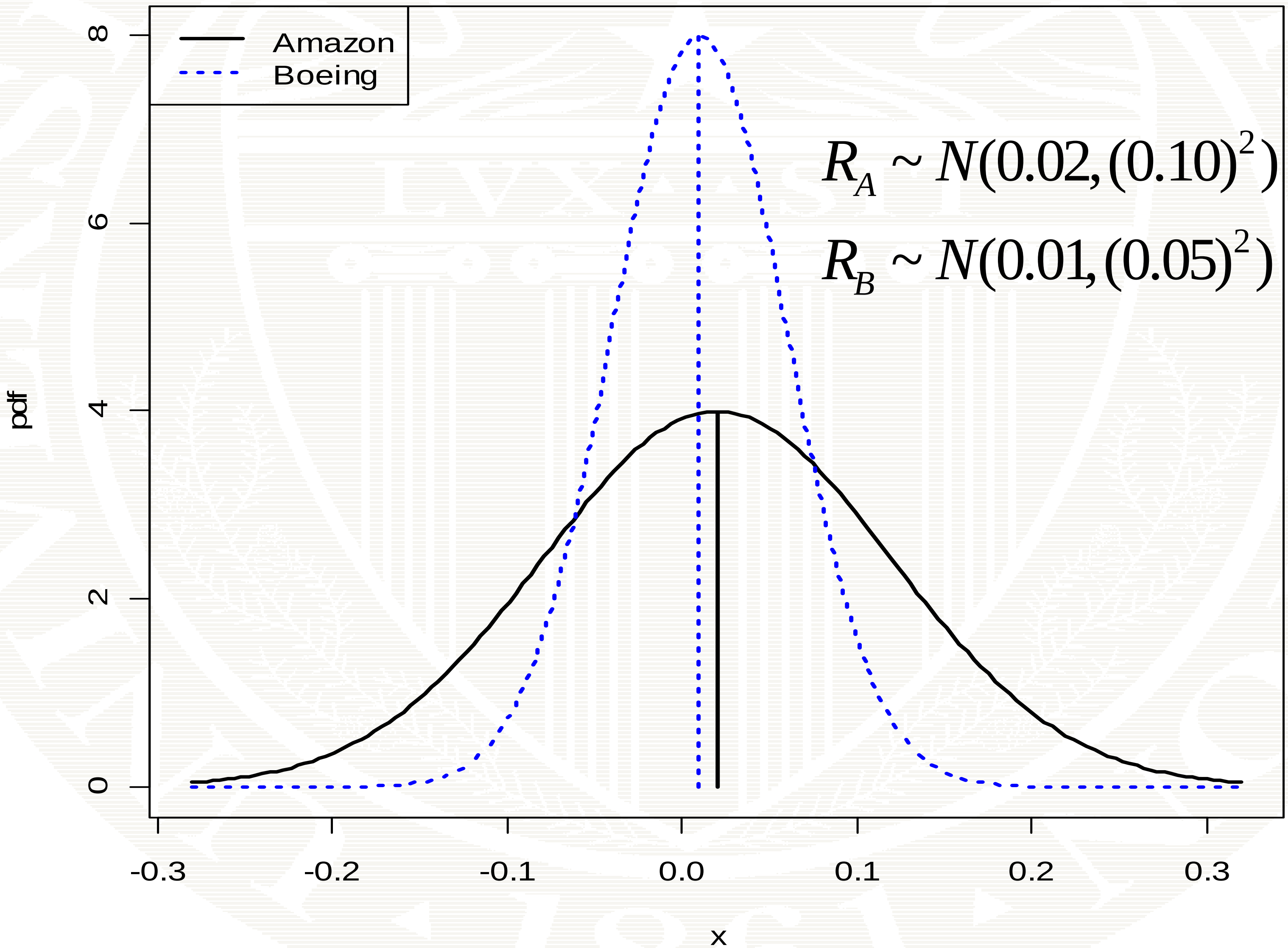

```
> x.vals = seq(-4, 4, length=150)
> plot(x.vals, dnorm(x.vals), type="l", lwd=2, col="blue",
+      xlab="x", ylab="pdf")
```

Standard Normal CDF

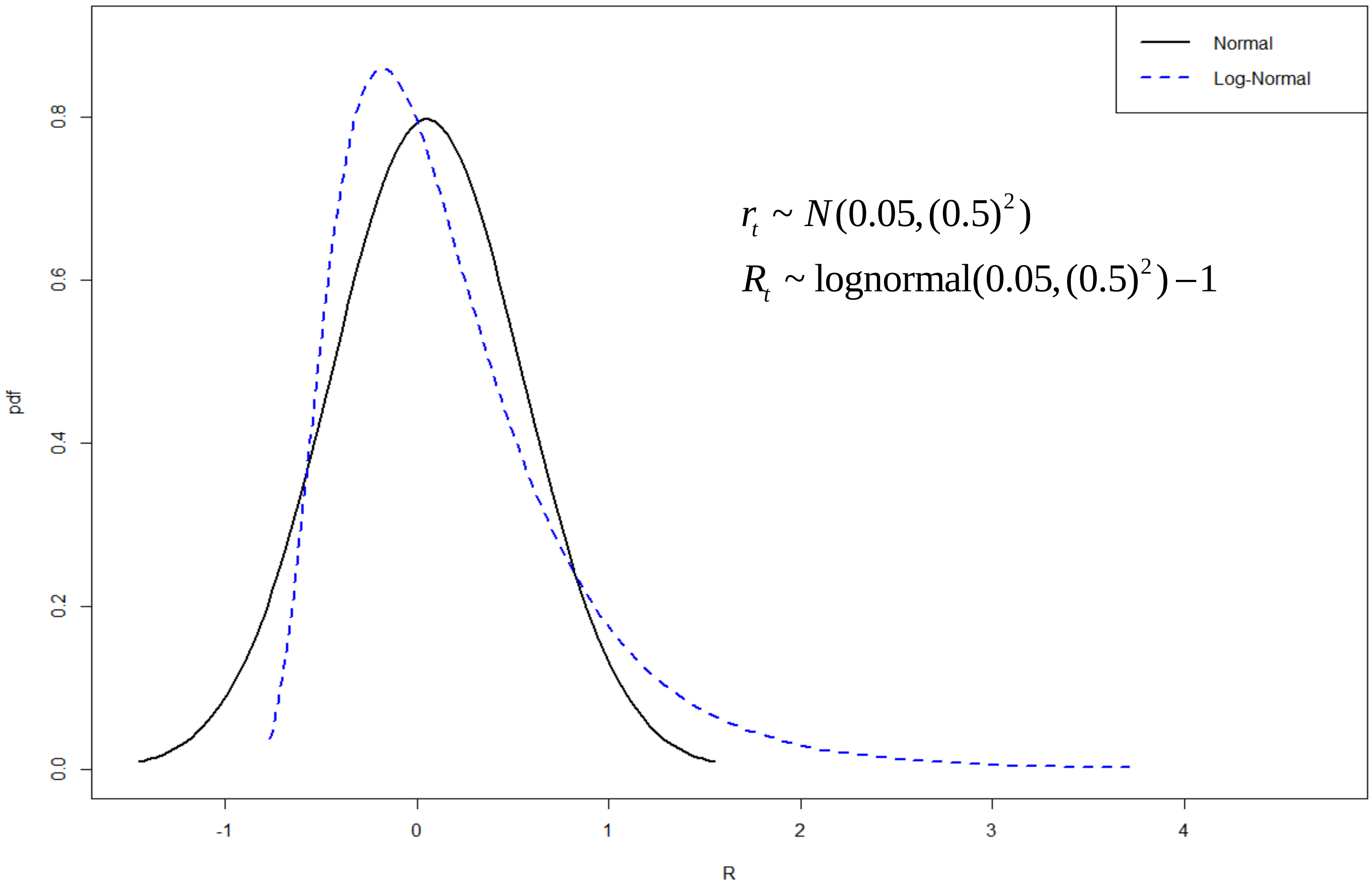



```
> x.vals = seq(-4, 4, length=150)
> plot(x.vals, pnorm(x.vals), type="l", lwd=2, col="blue",
+       xlab="x", ylab="CDF")
```

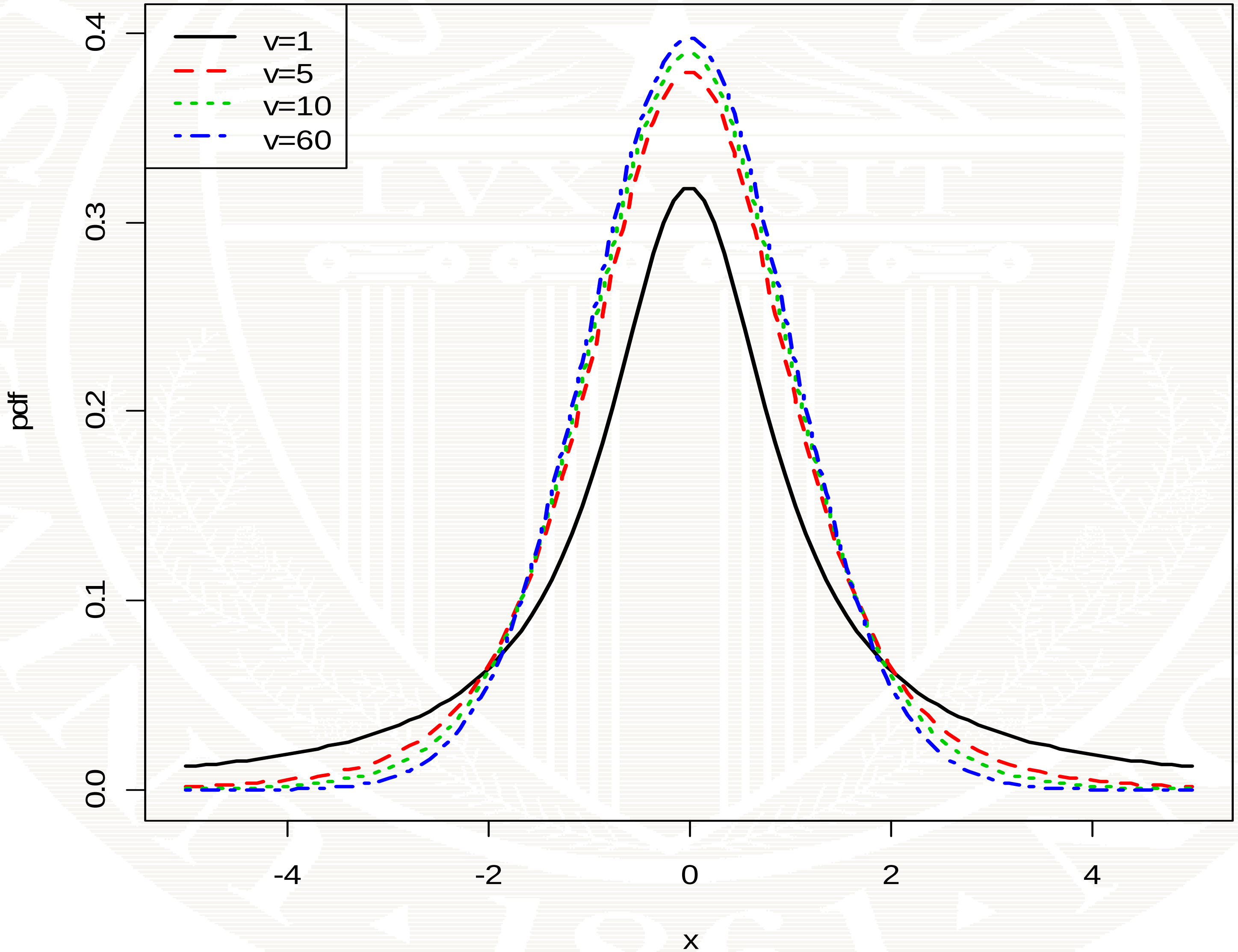
SD as a Measure of Risk



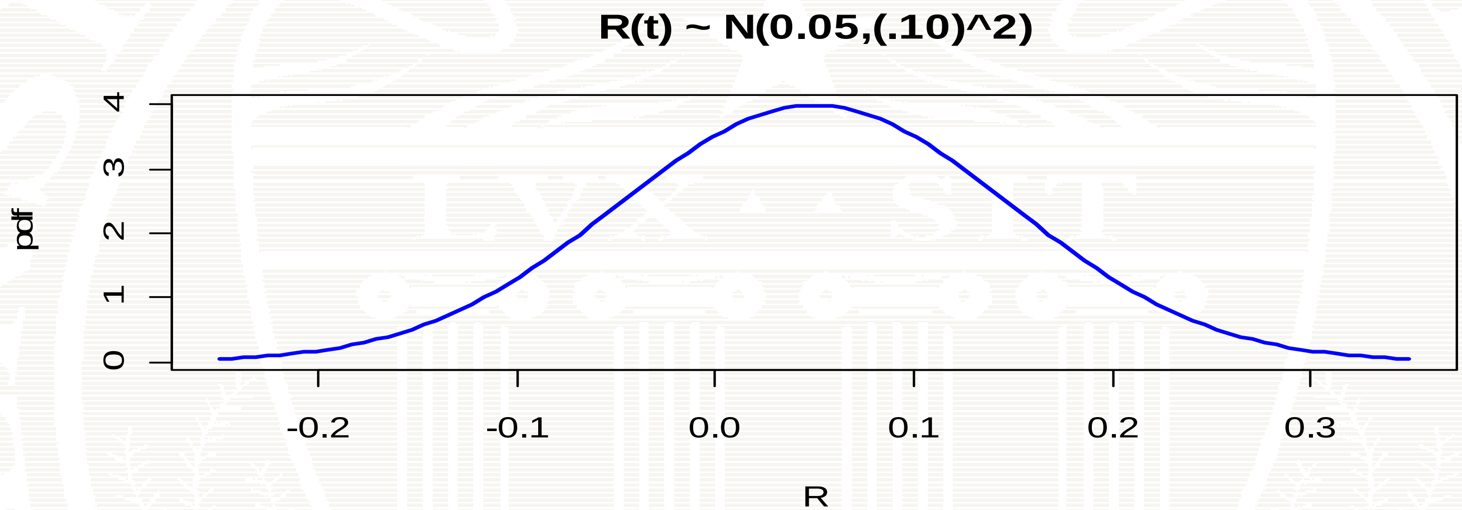
Normal vs. Log-Normal Distribution for Returns

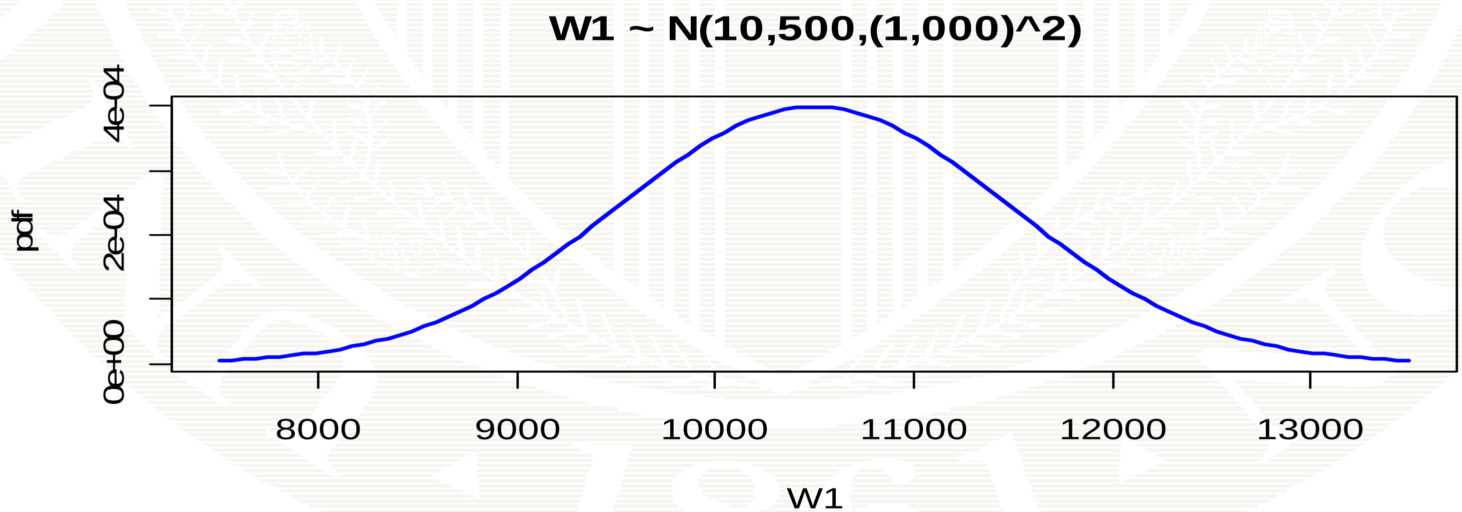


Student's t Distribution



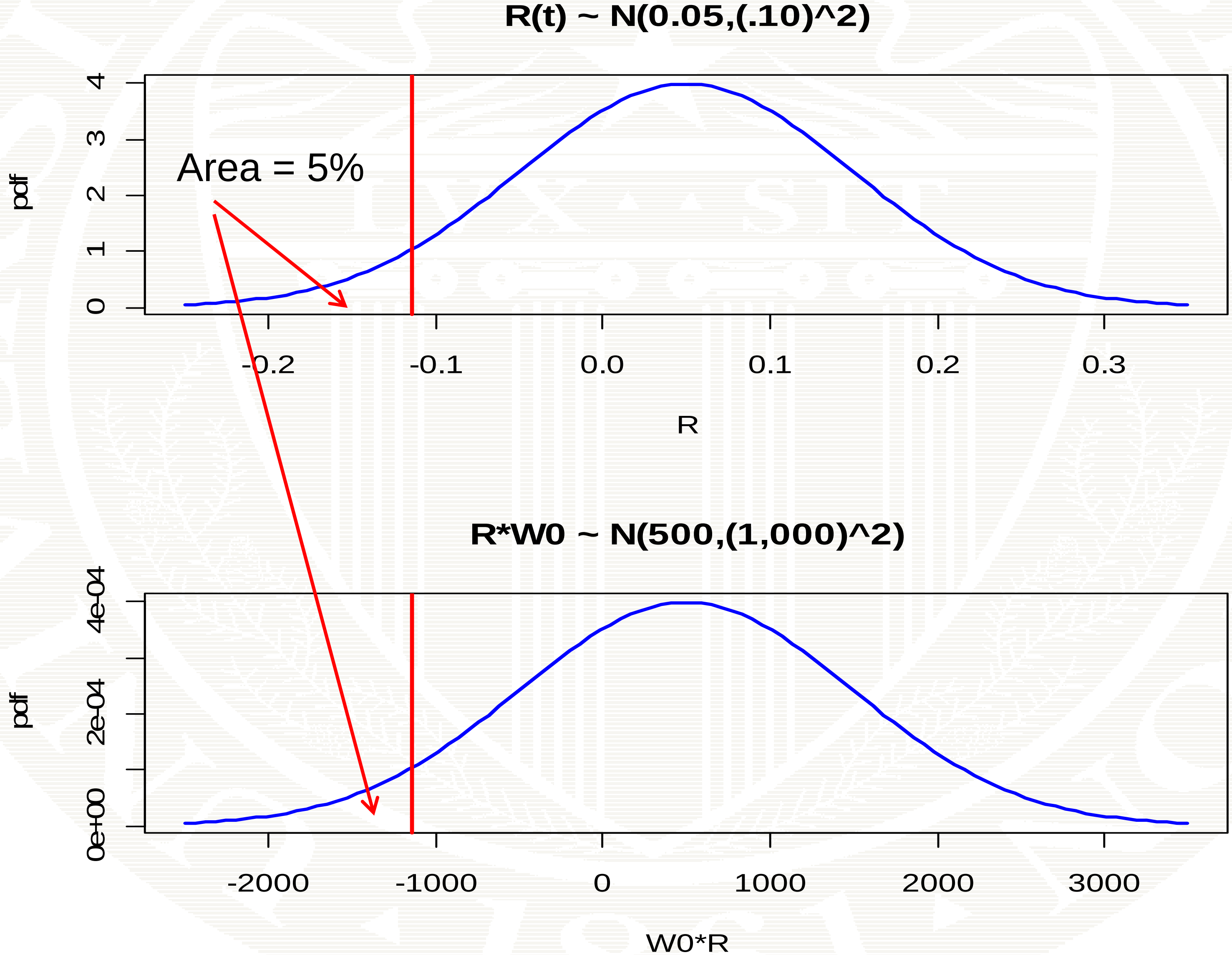
Return and Wealth Distributions



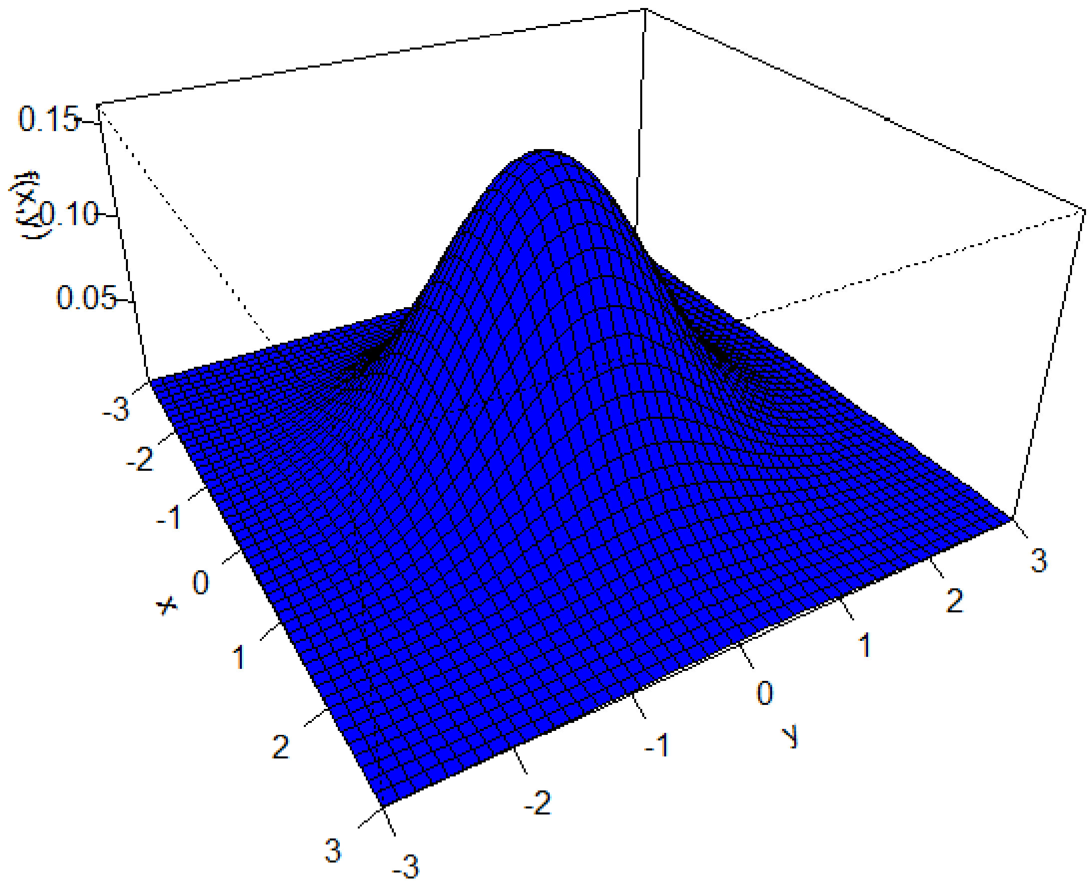


$\Pr(R \le q^{R}_{.05}) = 0.05$

5% Value-at-Risk

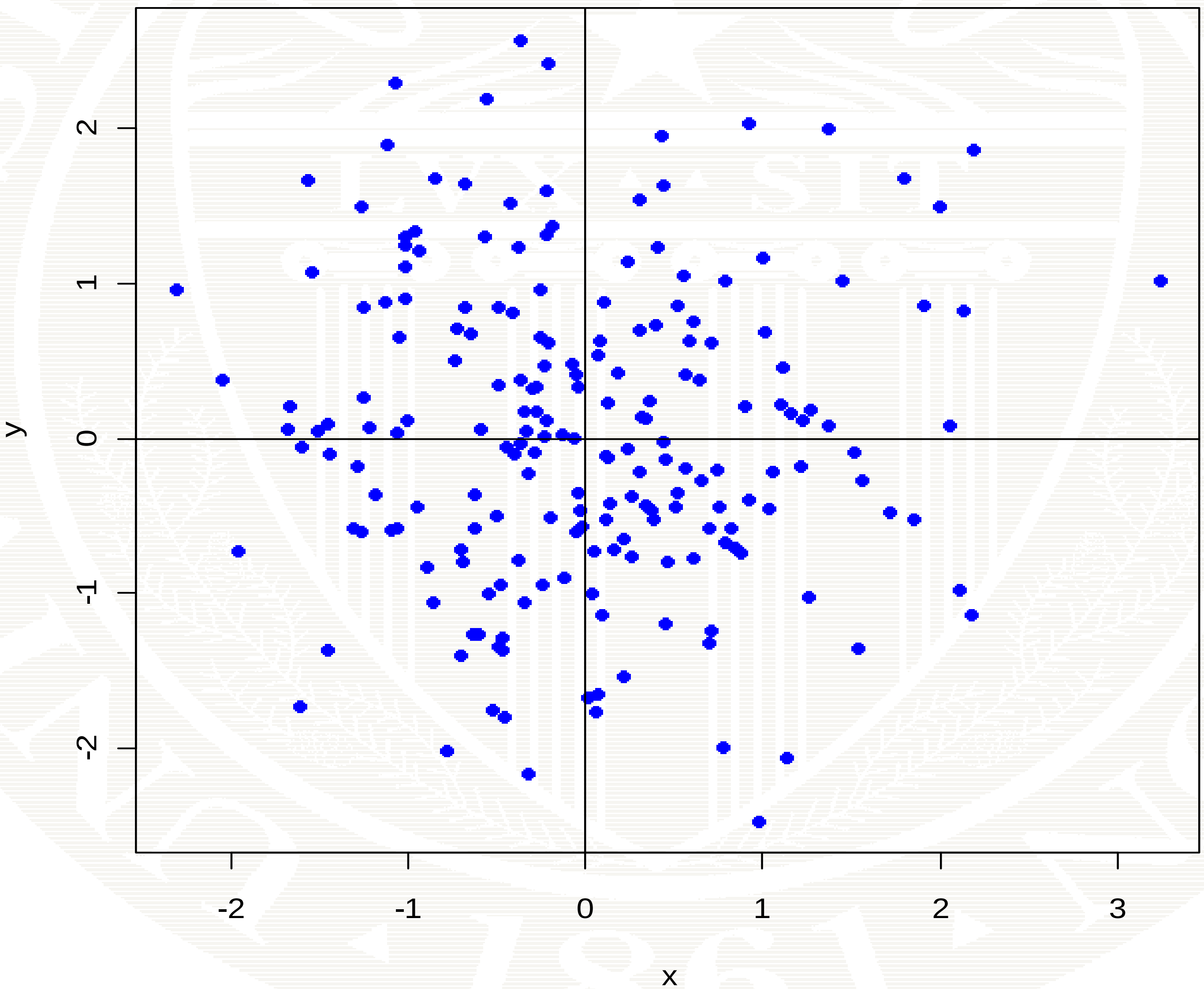


Bivariate Standard Normal

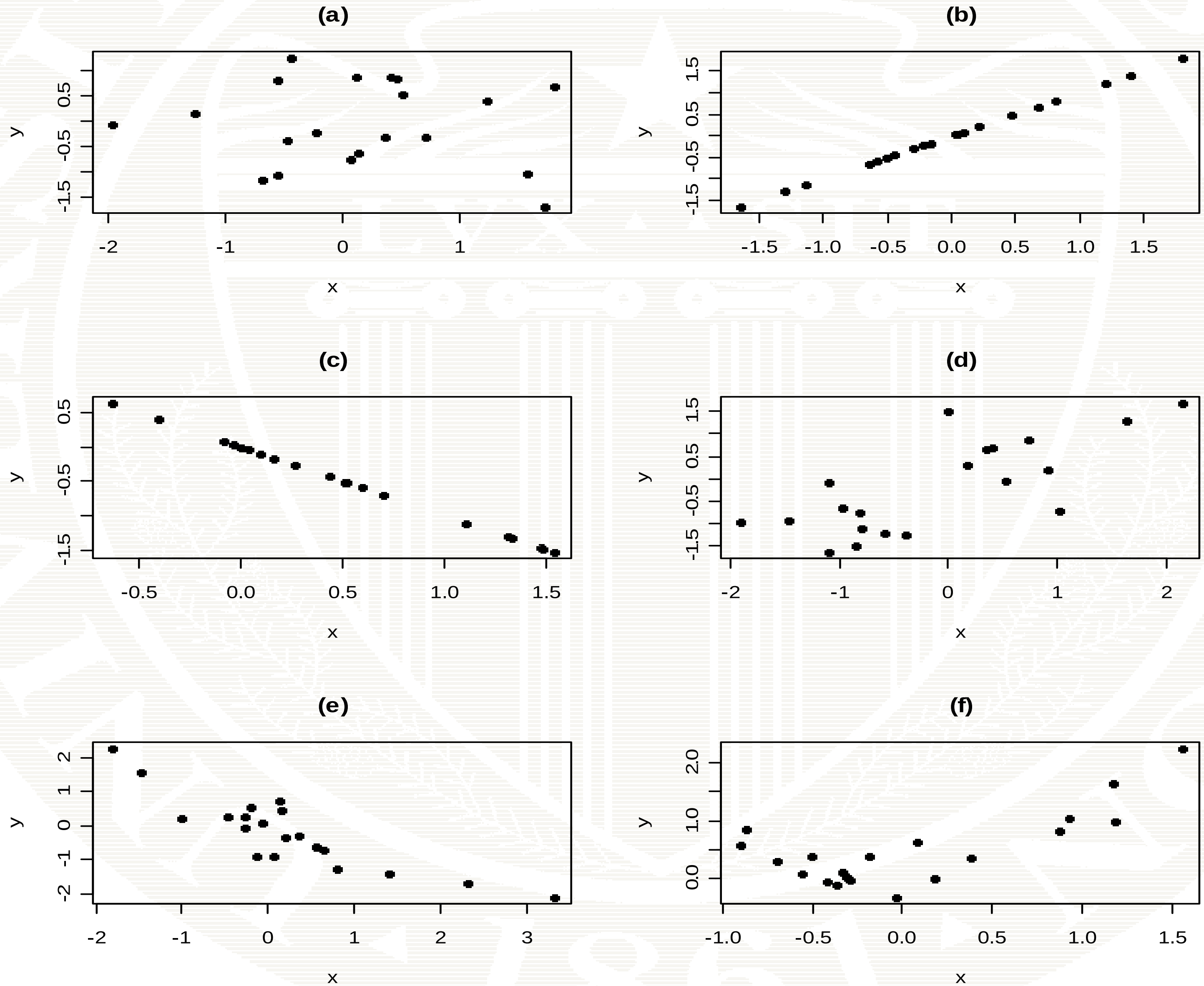



```
> pmvnorm(lower=c(-1, -1), upper=c(1, 1))
[1] 0.4661
```

Simulated Data from Bivariate Standard Normal

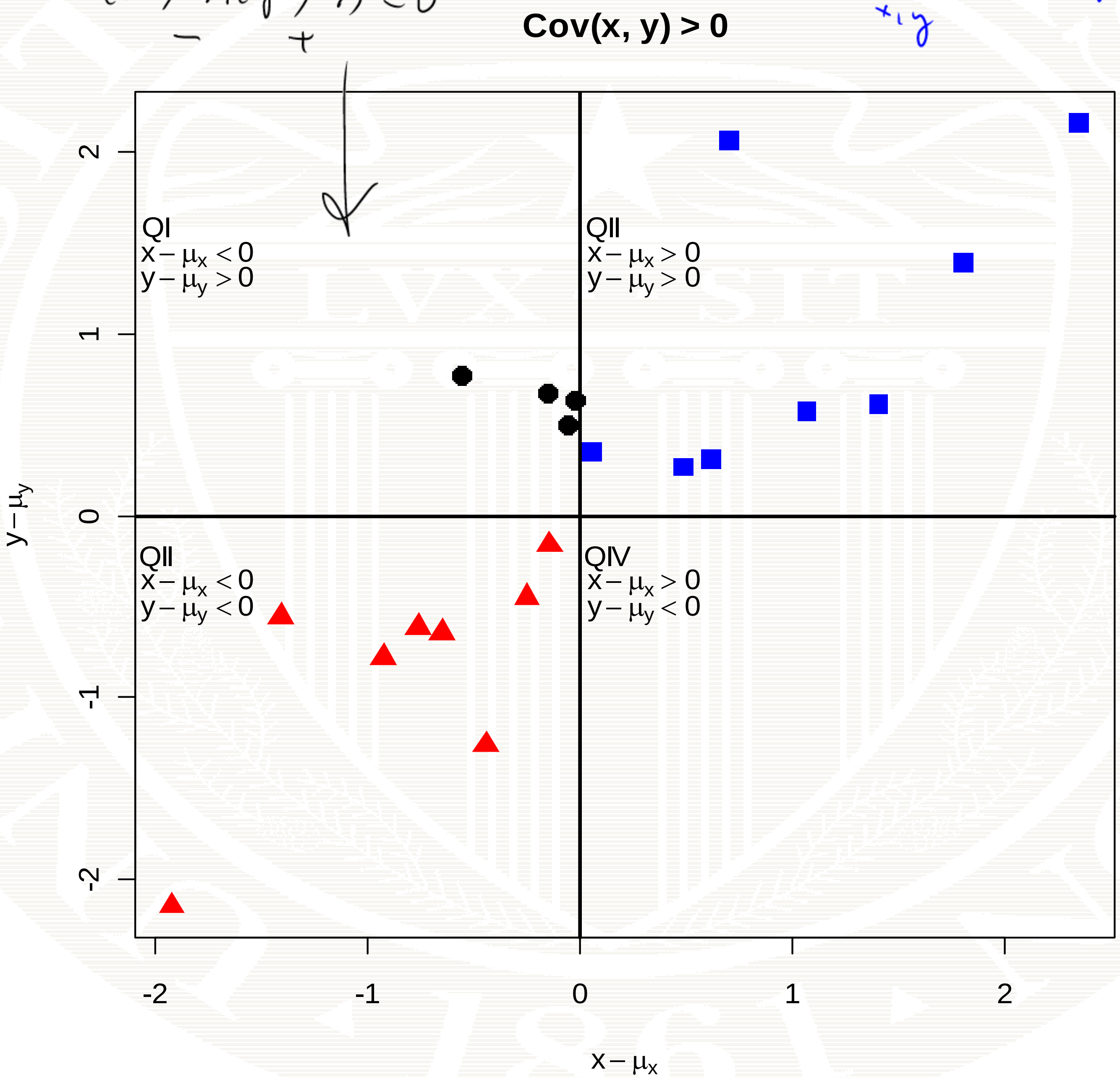


Probability Scatterplots



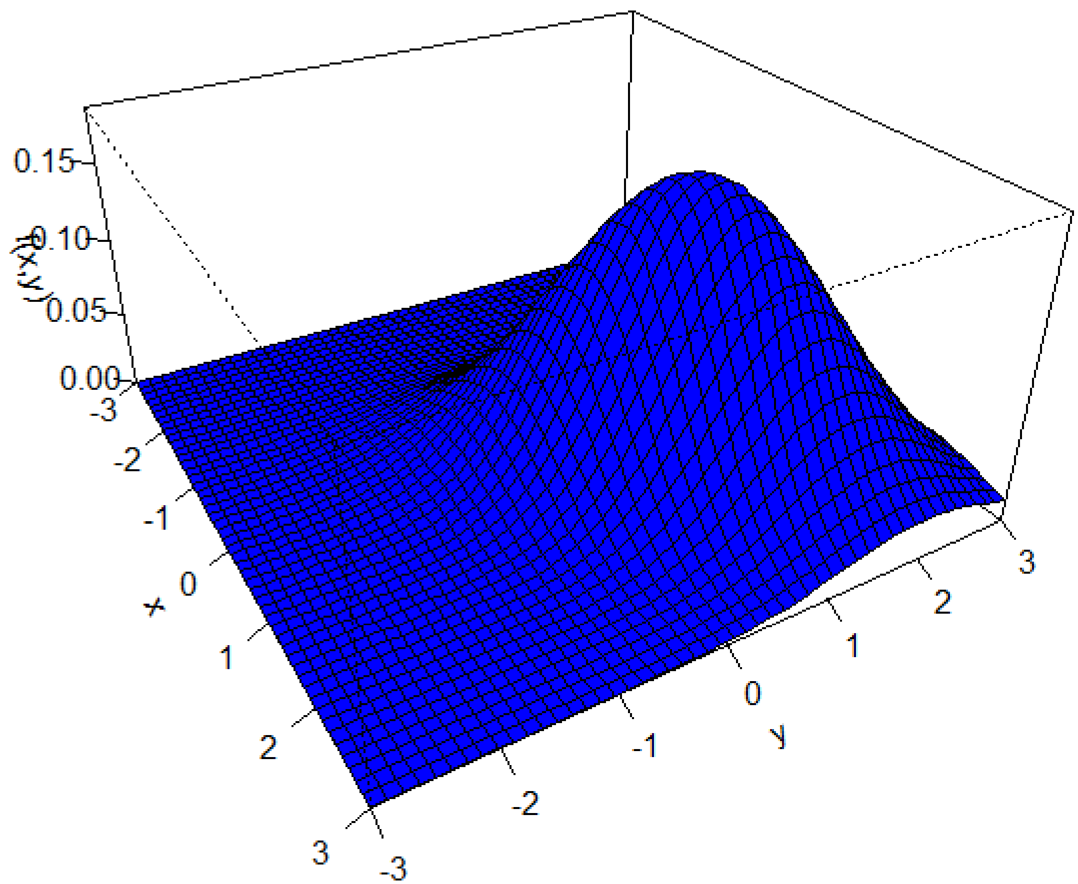
$Cov(x,y) = E[(x-\mu_x)(y-\mu_y)]$
$= \sum_{x,y} (x-\mu_x)(y-\mu_y) \cdot p(x,y)$

$(x-\mu_x)(y-\mu_y) < 0$
$-$ $+$



Bivariate Normal

$$\mu_X = \mu_Y = 1,\ \sigma_X = \sigma_Y = 1,\ \rho_{XY} = 0.5$$



Simulated Data from Bivariate Normal