# Quantitative Approaches to Software Security & Information Privacy

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**Core Proposition:** Address the threat that malicious individuals pose to the security of software systems and personal data not only as a technical problem but also as a human, and specifically an economic, problem.

*What level of security is required to successfully deter threats?*

## Economics of Software Security

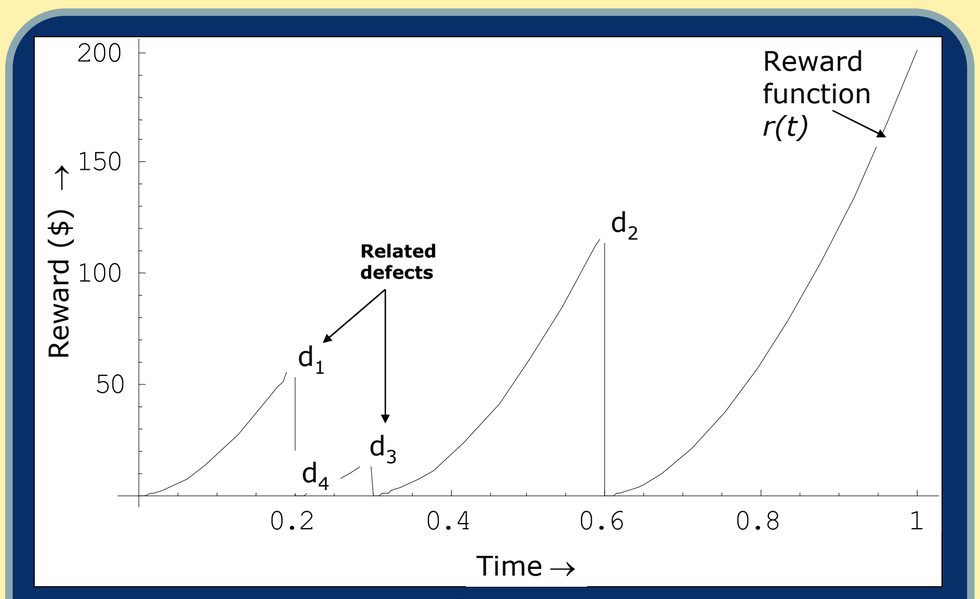
The *Security Risk* faced by a system in running a software package is a function of

1) the number of potential adversaries,
2) the adversaries' incentive to attack,
3) the risk posed to the adversary of attacking the system,
4) the time, effort, and other resources required in a successful attack.

To increase (4) is to increase the *Security Strength* of the software.

By determining the expected cost to find a vulnerability in a software system, we can begin to measure *Security Strength*.

By offering rewards for vulnerability discovery, software vendors can measure the security strength of their software using markets.




A bidding strategy for purchasing related and unrelated vulnerability reports.

Until recently, a small firm (iDefense) was the lone purchaser of vulnerability reports.

In 2005, a second buyer (TippingPoint) emerged, leading to the creation of a competitive market for vulnerability reports. This emerging market has been further legitimized by Verisign's purchase of iDefense and 3Com's purchase of TippingPoint.

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## Avoiding False Positives in Behavior-Based Worm Detection

### Previous Approaches

Network-based: Detect scanning worms by counting the number of connection failures. Trigger alarm when connection failures exceed threshold set high enough to avoid false positives (e.g., 100).

Host-based: Detect fast-spreading worms by comparing a host's current actions against its prior actions.

### Advances

Detect scanning worms by measuring success-to-failure ratio of outgoing connections to new hosts. Use sequential hypothesis testing to trigger alarms based on strength of the evidence. Alarms triggered in as few as ten outgoing connections with very few false positives.

Detect fast-spreading worms by comparing current actions against peers' current actions. We find that two peers, upon exchanging snapshots of their internal behavior, can decide that they are, more likely than not, both executing the same worm between 76% and 97% of the time.

*What technical mechanisms can we deploy to increase security & privacy in areas where security & privacy ultimately depend upon human behavior?*

## A Framework for Comparing Models of Information Privacy

Our framework evaluates privacy models based on:

1) Decision-making – deciding what information is worth protecting and controlling;
2) Negotiation – reaching agreements about the use of the protected information;
3) Enforcement – assuring that all parties abide by the negotiated rights.

| | Regulation | | | |
|---|---|---|---|---|
| | Self | Gov't | 3rd-Party | Markets |
| D'-making | Hard | Med | Med | Hard |
| Neg'n | Hard | Easy | Easy | Easy |
| Enfor't | Hard | Hard | Hard | Hard |

Example insight: No existing model adequately enforces privacy rules and audits privacy practices, but solving this issue is not sufficient.

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