# Fallout: Shelter

## A Game Mechanics Analysis

Aron Rindstedt  Max Block

August 12, 2015

# Introduction


- Postapocalyptic mobile game
- You control a shelter full of dwellers
- One thing dwellers can do is scout
- Scouts retrieve bottlecaps and items
- Scouts face deadly challenges

# Character Stats

- SPECIAL stats ($\in 1..10 + \text{bonus}$)
  - Strength
  - Perception
  - Endurance
  - Charisma
  - Intelligence
  - Agility
  - Luck
  - Bonus from armour (blue)
- Level (assumed to be discrete)
- Happiness (assumed to be insignificant)
- Weapon damage

# Scouting

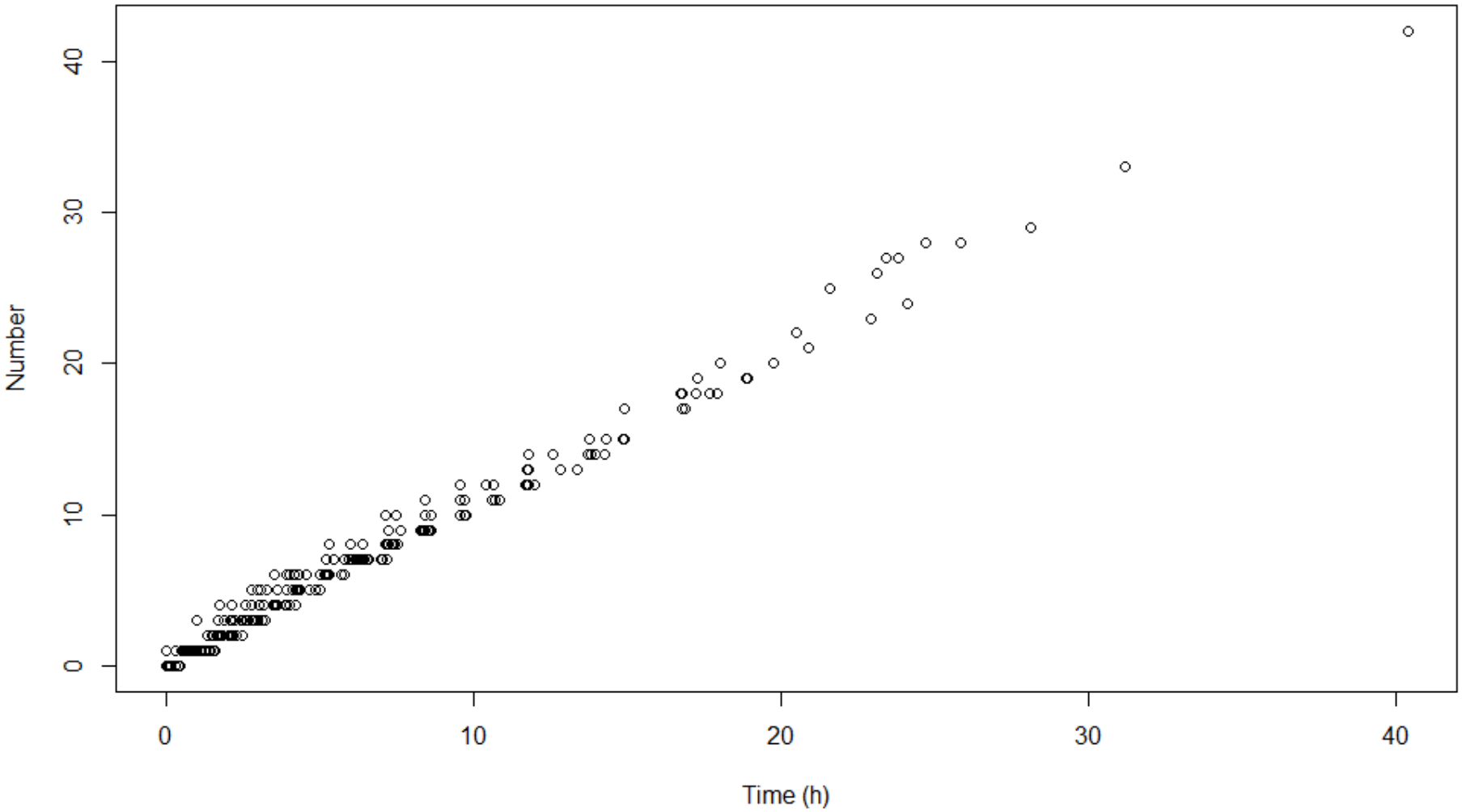
- We wanted to know what determined how fast a scout found items and bottlecaps
- We performed a linear analysis and looked at the p-values
- The goal is to figure out if some dwellers are better scouts than others

# Items Per Hour

Table: Number of items per hour

| | Estimate Std. | Error | t value | Pr(>\|t\|) | |
|---|---|---|---|---|---|
| (Intercept) | 1.290960 | 0.771921 | 1.672 | 0.0959 | . |
| level | -0.021353 | 0.017178 | -1.243 | 0.2152 | |
| dmg | -0.060882 | 0.057463 | -1.059 | 0.2906 | |
| s | -0.003986 | 0.055532 | -0.072 | 0.9428 | |
| p | -0.079242 | 0.095350 | -0.831 | 0.4069 | |
| e | 0.031539 | 0.070731 | 0.446 | 0.6561 | |
| c | -0.057148 | 0.091382 | -0.625 | 0.5324 | |
| i | 0.324587 | 0.335993 | 0.966 | 0.3351 | |
| a | 0.214665 | 0.133610 | 1.607 | 0.1096 | |
| l | 0.042945 | 0.073570 | 0.584 | 0.5600 | |

# Items Per Hour



# Conclusion: Items

- Difficult to determine what affects items found. Two p-values stand out, but are still bad.
  - Intercept has p-value 0.096
  - Agility has p-value 0.11

# Conclusion: Items

- Difficult to determine what affects items found. Two p-values stand out, but are still bad.
  - Intercept has p-value 0.096
  - Agility has p-value 0.11
  - Probably constant, but we need more data to be sure.

# Caps Per Hour

Table: Average number of caps per hour

| | Estimate | t value | Pr(>\|t\|) | |
|---|---|---|---|---|
| (Intercept) | 83.81787937 | 11.63356 | <2e-16 | *** |
| s | -0.21649106 | -0.43309 | 0.665802 | |
| p | 0.61211724 | 0.91113 | 0.364235 | |
| e | -0.88781188 | -1.67151 | 0.097489 | . |
| c | -0.18453188 | -0.31035 | 0.756888 | |
| i | 0.19836365 | 0.35132 | 0.726024 | |
| a | -0.04815488 | -0.08799 | 0.930043 | |
| l | 13.48815469 | 26.55579 | <2e-16 | *** |
| start.level | -0.68088744 | -4.25171 | 0.00004495 | *** |
| start.damage | -1.56703535 | -1.97083 | 0.051278 | . |
| level.increase | -3.44085855 | -1.97599 | 0.050683 | . |
| death.damage | 0.30906873 | 0.88693 | 0.377067 | |

# Conclusion: Caps

- Caps found determined by Luck (p-value $<$ machine $\varepsilon$). There's also a base value (intercept).
  - Also a small but clearly negative correlation with level, hard to tell why this is.

# Survival

- Scouts face a variety of threats.
- Threats can deal damage both as lost hit points and radiation, too much of either results in death.
- Death is nonpermanent but expensive.
- By calculating the expected time of death for a scout we can choose how long we dare to let our scouts roam.

# Summary: Survival Time

Table: Survival time

| | Estimate Std. | Pr(>\|t\|) | |
|---|---|---|---|
| (Intercept) | -0.62884167069 | 0.074911 | . |
| s | 0.05346141178 | 0.017339 | * |
| p | 0.02862342249 | 0.336994 | |
| e | 0.18123434236 | 9e-11 | *** |
| c | 0.01608604571 | 0.543637 | |
| i | 0.05055419848 | 0.052260 | . |
| a | 0.02581622298 | 0.289351 | |
| l | -0.26496311935 | 3e-7 | *** |
| start.level | 0.11302287177 | <2e-16 | *** |
| start.damage | 0.14667002834 | 7e-4 | *** |
| level.increase | 0.55390718215 | 3e-8 | *** |
| caps | 0.00310366533 | 8e-8 | *** |
| death.damage | 0.01143465929 | 0.475960 | |

# Survival: Tested Models

- The best p-values among the controllable variables belong to endurance, luck, level, and starting damage.
- Selected models
  - Linear model over all four
  - Higher order polynomial models over (exactly) one predictor
  - Random forest

# Survival: Performance

- Since we only have limited data, error values vary, but the order is largely consistent.
- We used squared logarithmic errors.

| | **Model** | **MSLE** |
|---|---|---|
| 1 | Linear | 0.03840157 |
| 2 | E-cubed | 0.04011285 |
| 3 | E-squared | 0.04022501 |
| 4 | L-squared | 0.04054431 |
| 5 | L-cubed | 0.0405978 |
| 6 | Level-squared | 0.0443507 |
| 7 | Level-cubed | 0.04464607 |
| 8 | Random forest | 0.07228656 |

# Survival: Performance

- Linear data summary

Table: Coefficients

| | Estimate | Std. Error | t value | Pr(>\|t\|) | |
|---|---|---|---|---|---|
| (Intercept) | -0.666776 | 0.423767 | -1.573 | 0.120256 | |
| e | 0.152480 | 0.042116 | 3.621 | 0.000561 | *** |
| l | 0.067931 | 0.041358 | 1.642 | 0.105105 | |
| start.level | 0.144418 | 0.009735 | 14.834 | < 2e-16 | *** |
| start.damage | 0.374476 | 0.056063 | 6.680 | 5.33e-09 | *** |

# Survival: Conclusions

- A rough guess for the survival time of a given scout appears to be $(0.15(e + \mathit{level}) + 0.4 \cdot \mathit{damage})$ hours.
- Performance varies wildly between tests, more data/more thorough analysis might be prudent.

# Questions

Any questions?