Fallout: Shelter

A Game Mechanics Analysis

Aron Rindstedt   Max Block

August 12, 2015

Introduction

- Postapocalyptic mobile game.
- You control a shelter full of dwellers.
- Dwellers can scout the wasteland.
  - Scouts retrieve bottlecaps and gear.

Character Stats

- SPECIAL stats
  ($\in 1..10 +$ 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
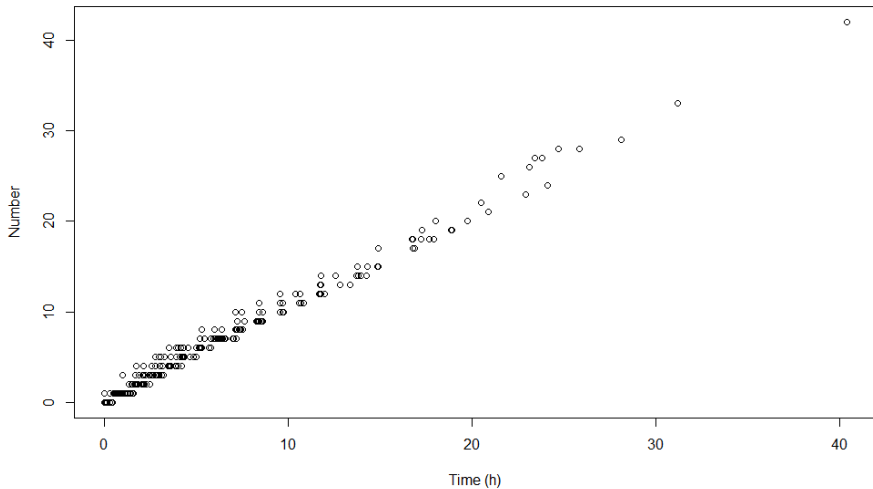
Conclusion: Items

- 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 ε). There's also a base value (intercept).
    - Also a small but clearly negative correlation with level, hard to tell why this is.

Survival: Intro

- Scouts run into dangerous foes and radiation.
- Opponents can deal damage to hit points, radiation lowers the hit point cap.
  - ▶ A dweller with no more health dies
  - ▶ Death is nonpermanent but expensive.

Any Game of Thrones fan's nightmare...

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: Significance of predictors in a linear model

	Estimate	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 the damage of the equipped weapon.
- We discarded number of caps and level increase since we can not use them.
- Selected models
  - Linear model over all predictors
  - 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.

	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

- Since we only have limited data, error values vary, but the order is largely consistent.
- The polynomial models are using very small values for the higher orders, essentially of degree 1.

Survival: Selected Model

- 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 is $(0.15(e + level) + 0.4 \cdot damage)$ hours.
- Performance varies greatly due to noise, need more data for a more exact model.

Any questions?