Exploration and Exploitation: Persistence with local exploration under varying resource distribution, resource availability over time and cost of relocation

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Exploration and Exploitation

- Organisms, Individuals and Organizations face the dilemma of exploration vs. exploitation
- Identifying the optimal trade-off between the two is a challenge
- Too much exploration (e.g. gaining new knowledge) can be detrimental to day-to-day survival and too much exploitation (applying existing knowledge) could be detrimental to long term survival esp. if conditions change over time

ODD Protocol

Purpose: The purpose of the model is to investigate how the amount of resources acquired (wealth/success) is related to persistence with the strategy of local exploration under different resource distributions, availability of resources over time and cost of relocation

Entities, state variables, and scales: Entities are agents representing organisms, individuals or organizations, called *explorers*. State variables keep track of explorers' *current patience*, a measure of persistence. When an agent's patience runs out, the agent decides to abandon ones area and move elsewhere for exploration. Agents are heterogenous in terms of their degree of persistence. Another state variable, *wealth*, measures the amount of resources gathered.

Resources are represented as green-colored patches. Each patch has a resource value drawn from a uniform distribution.

Time is represented conceptually.

ODD Protocol

Process overview and scheduling: Agents (explorers) are scattered randomly through the landscape and move around randomly. If they come across a resource (green patch), they will acquire the resource i.e. their wealth will increase. In the declining resources scenario, the green patch will change color to default color to indicate that the resource is no longer available.

When the agent does not come across a resource, its patience decreases. When an explorer's patience runs out, it would be ready to explore a completely new area and would move to a random new location.

The agents have to pay a one-time *moving cost* which remains the same for all agents for the entire run of the simulation.

ODD Protocol

Design concepts: Agents (explorers) are able to sense the presence or absence of a resource. If resources are renewable, the overall resources remain constant or may grow over time. Explorers have goals to acquire as many resources as possible that are distributed in a given environment.

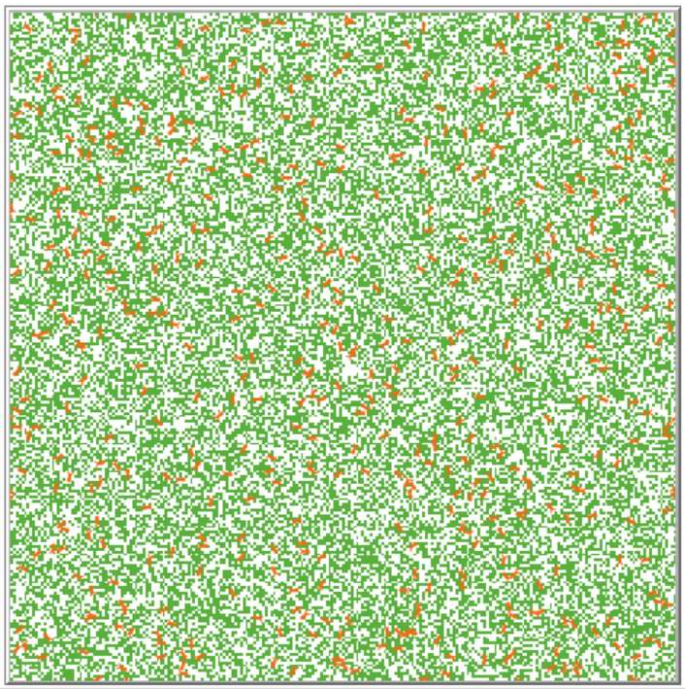
Assumptions

- Exploitation: search locally, low cost but ongoing
- Exploration: search new locations, high one-time high cost (e.g. migration to new location, investment in new technology)
- Agents persist with local exploration until a threshold after which they move (randomly) to a new location
- Agents wealth increases depending on the number of resources encountered and the value of resource harvested.

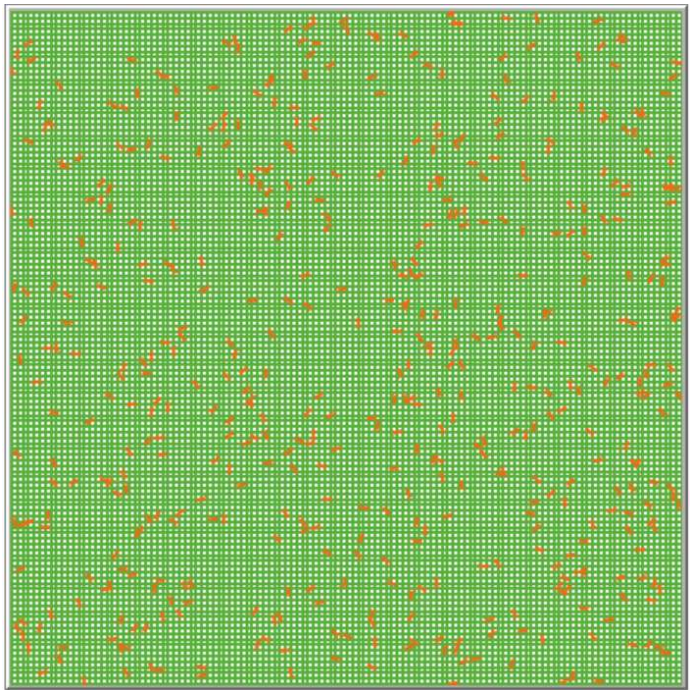
At the end of each run, data is collected on the amount of resources acquired (wealth) and the degree of persistence (how long will an agent explore locally before moving elsewhere) of each agent.

Resource Distribution Patterns

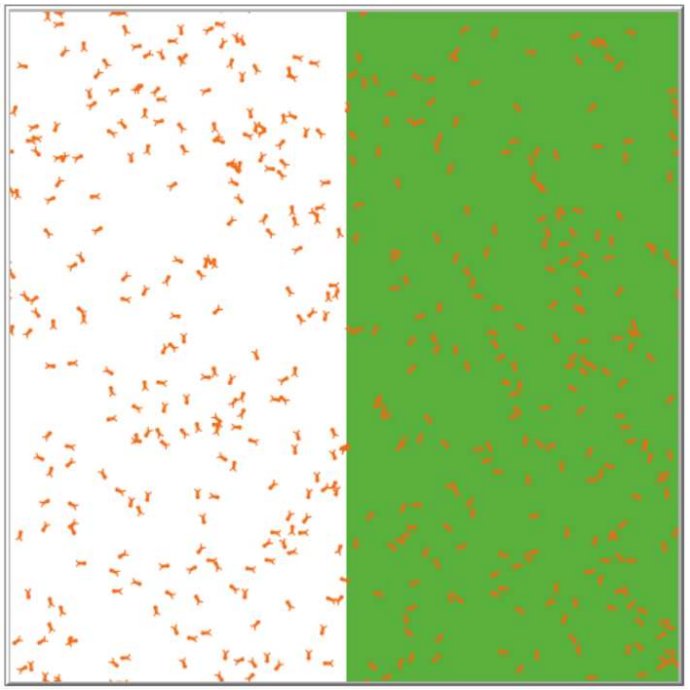
Random Distribution



Uniform Distribution

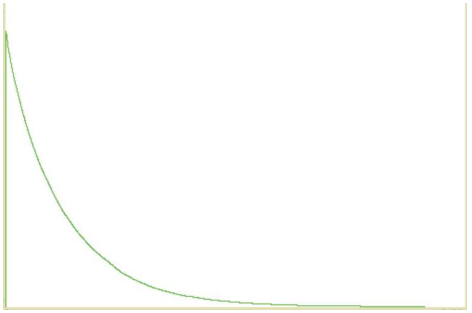


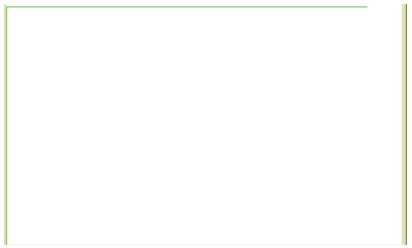
Concentrated Distribution

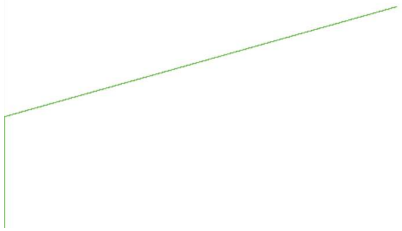


Resource Availability Over Time

- Declining (exponentially) – Resources are non-renewable and so decline is influenced by how many agents are harvesting
- Remaining steady (constant) – resources are replenished
- Growing (linearly) – resources grow over time







ODD Protocol

Initialization: Once explorer agents are created, a degree of persistence (initial-patience) is assigned which is drawn from a uniform distribution. When an agent's patience runs out and moves to another location, this initial value will be used to re-initialize their degree of persistence.

Each agent also begins with the same initial wealth. This wealth may increase or decrease over time.

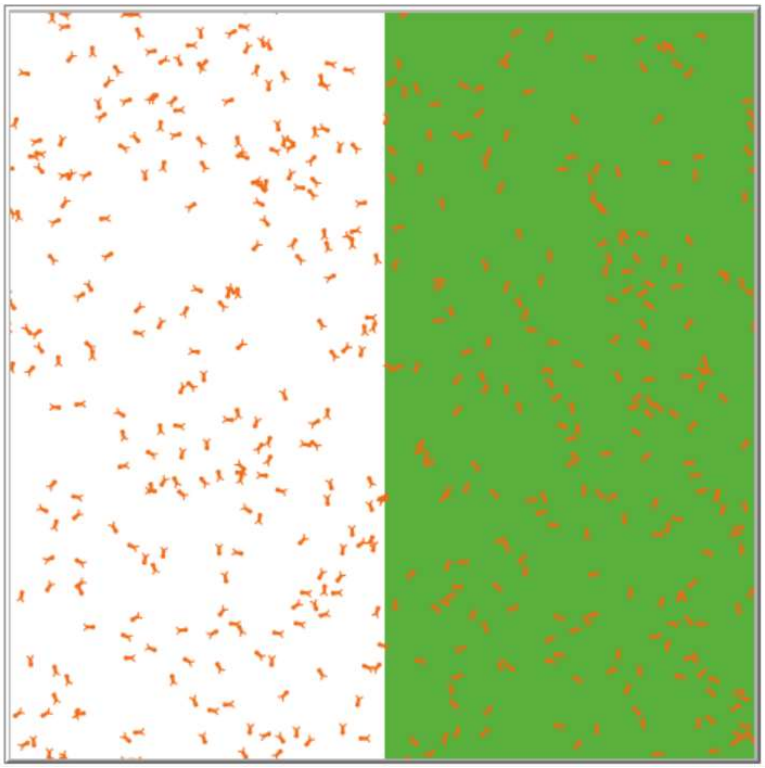
Analysis

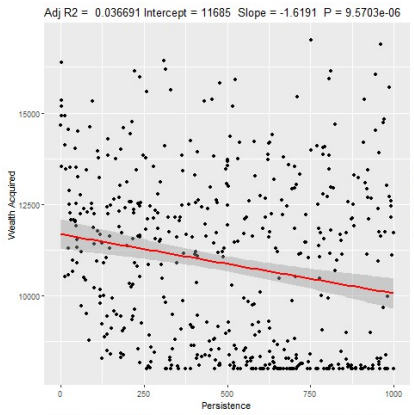
Simulation Experiment

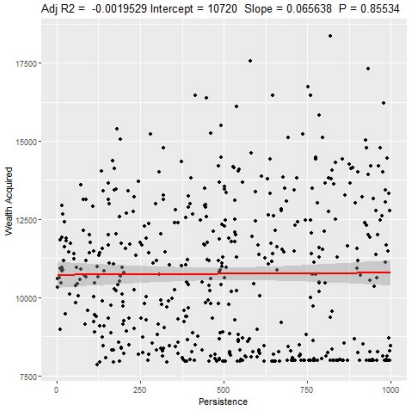
- 3 (Resource Distribution Patterns) X 3 (Resource Availability Over Time) x 21 (Varying Moving Cost: 0 units – 200 units increments of 10)

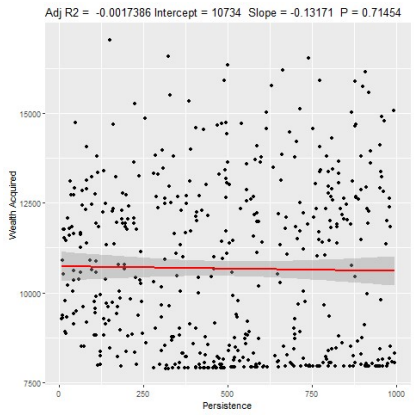
Relationship between Persistence and Wealth Acquired

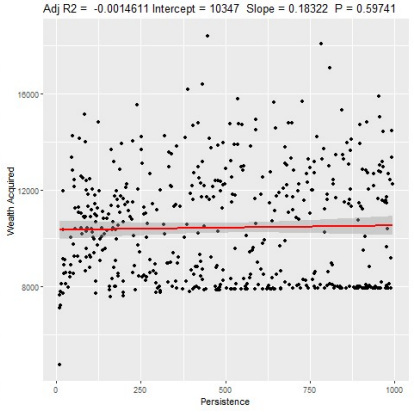
- Resources concentrated in a region – Declining Over Time

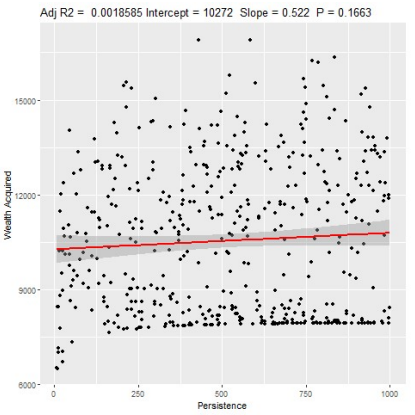


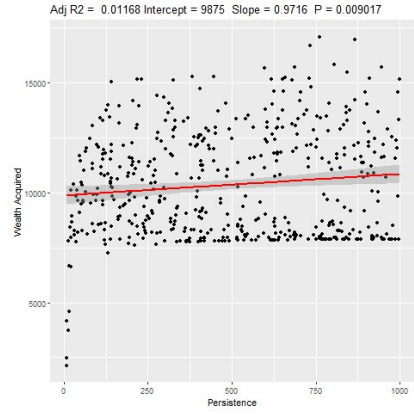

Adj R2 = 0.036691 Intercept = 11685 Slope = -1.6191 P = 9.5703e-06
Wealth Acquired
Persistence

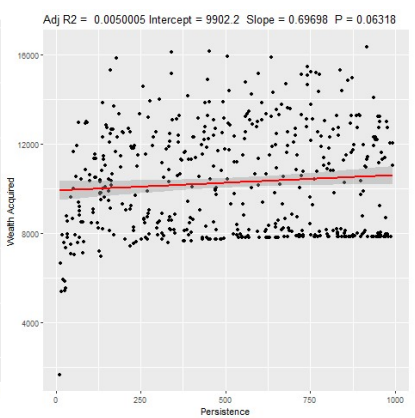

Adj R2 = -0.0019529 Intercept = 10720 Slope = 0.065638 P = 0.85534
Wealth Acquired
Persistence

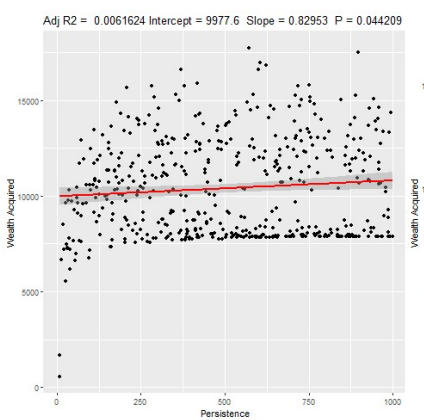

Adj R2 = -0.0017386 Intercept = 10734 Slope = -0.13171 P = 0.71454
Wealth Acquired
Persistence

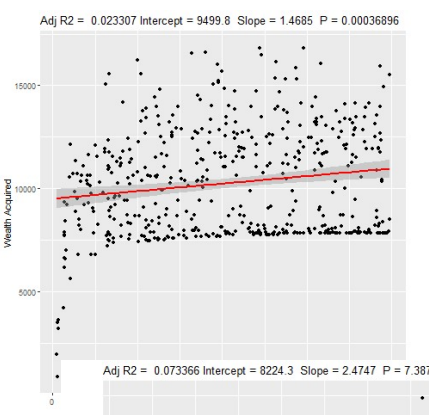

Adj R2 = -0.0014611 Intercept = 10347 Slope = 0.18322 P = 0.59741
Wealth Acquired
Persistence

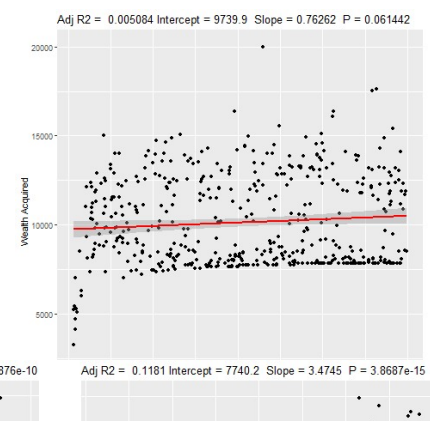

Adj R2 = 0.0018585 Intercept = 10272 Slope = 0.522 P = 0.1663
Wealth Acquired
Persistence

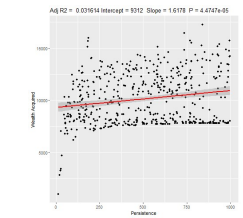

Adj R2 = 0.01168 Intercept = 9875 Slope = 0.9716 P = 0.009017
Wealth Acquired
Persistence

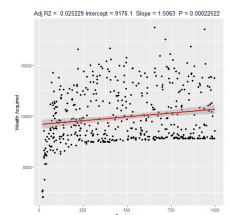

Adj R2 = 0.0050005 Intercept = 9902.2 Slope = 0.69698 P = 0.06318
Wealth Acquired
Persistence

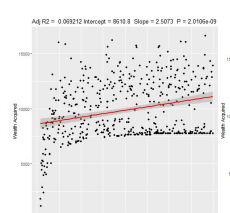

Adj R2 = 0.0061624 Intercept = 9977.6 Slope = 0.82953 P = 0.044209
Wealth Acquired
Persistence

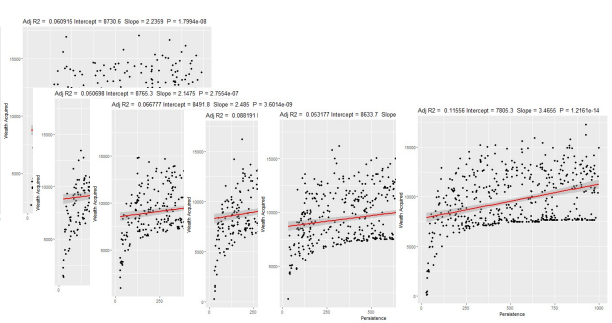

Adj R2 = 0.023307 Intercept = 9499.8 Slope = 1.4685 P = 0.00036896
Wealth Acquired

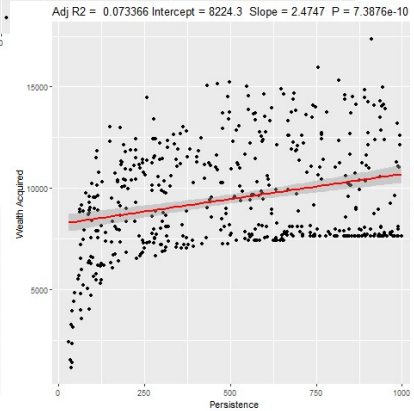

Adj R2 = 0.005084 Intercept = 9739.9 Slope = 0.76262 P = 0.061442
Wealth Acquired
Persistence

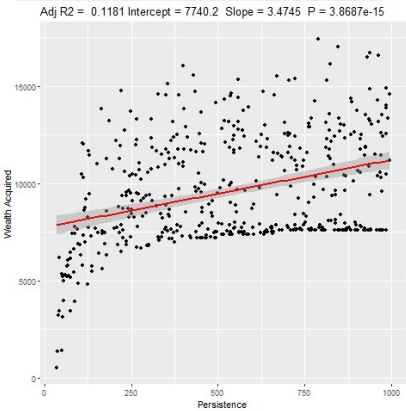

Adj R2 = 0.031614 Intercept = 9312 Slope = 1.6178 P = 4.4747e-05


Adj R2 = 0.025229 Intercept = 9176.1 Slope = 1.5063 P = 0.00022522

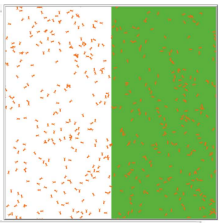

Adj R2 = 0.069212 Intercept = 8610.8 Slope = 2.5073 P = 2.0106e-09

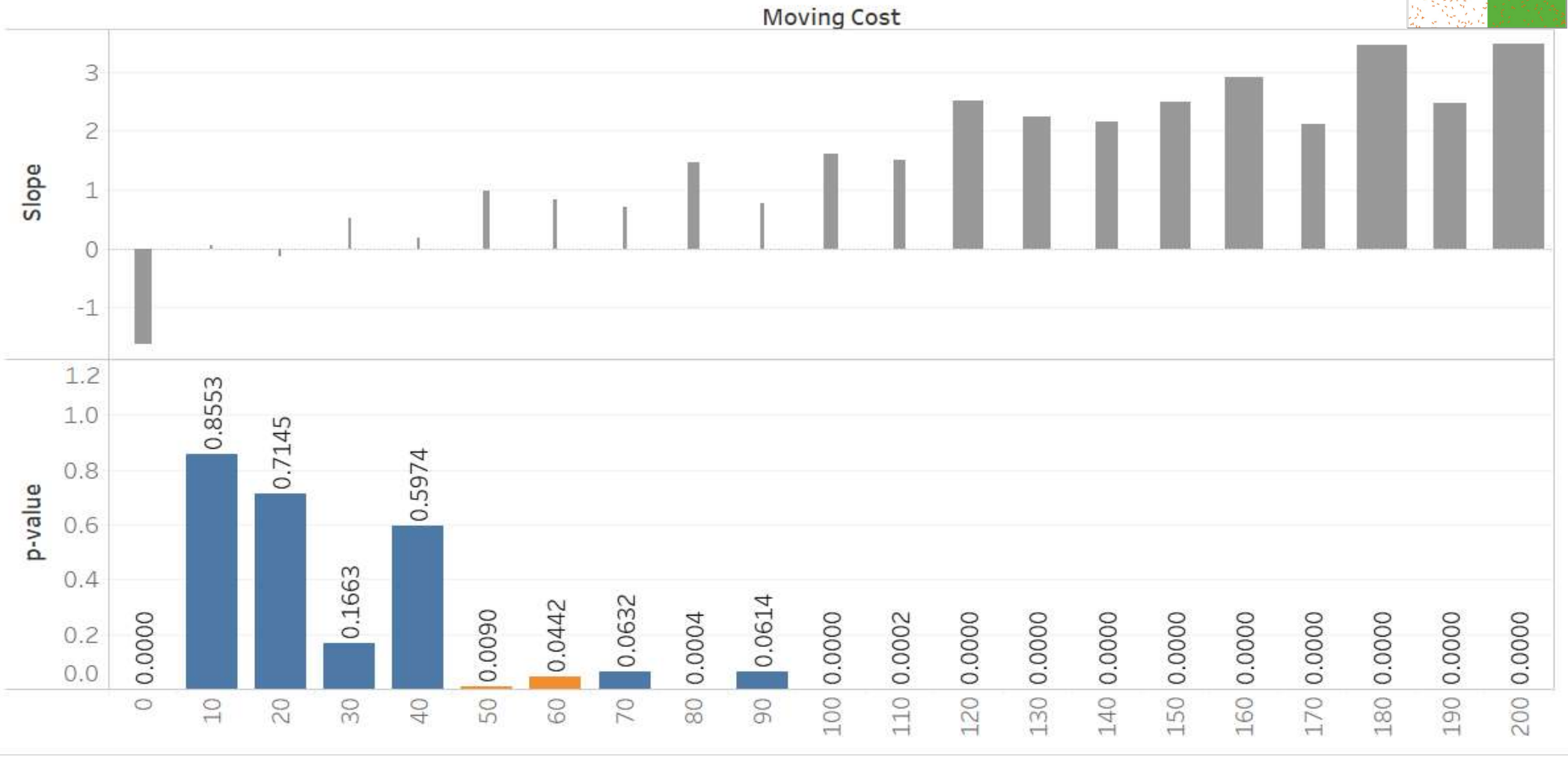

Adj R2 = 0.060915 Intercept = 8730.6 Slope = 2.2359 P = 1.7994e-08
Adj R2 = 0.050698 Intercept = 8765.3 Slope = 2.1475 P = 2.7554e-07
Adj R2 = 0.066777 Intercept = 8491.8 Slope = 2.485 P = 3.6014e-09
Adj R2 = 0.088191
Adj R2 = 0.053177 Intercept = 8633.7 Slope
Adj R2 = -0.11556 Intercept = 7805.3 Slope = 3.4655 P = 1.2161e-14


Adj R2 = 0.073366 Intercept = 8224.3 Slope = 2.4747 P = 7.3876e-10
Wealth Acquired
Persistence


Adj R2 = 0.1181 Intercept = 7740.2 Slope = 3.4745 P = 3.8687e-15
Wealth Acquired
Persistence

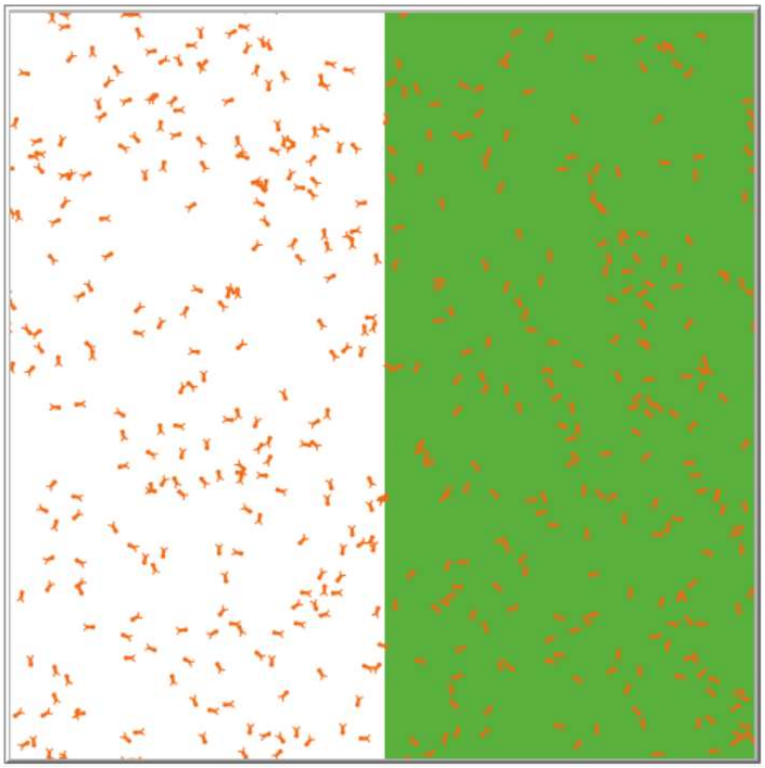
Landscape - Concentrated Resources
Scenario - Declining Resources

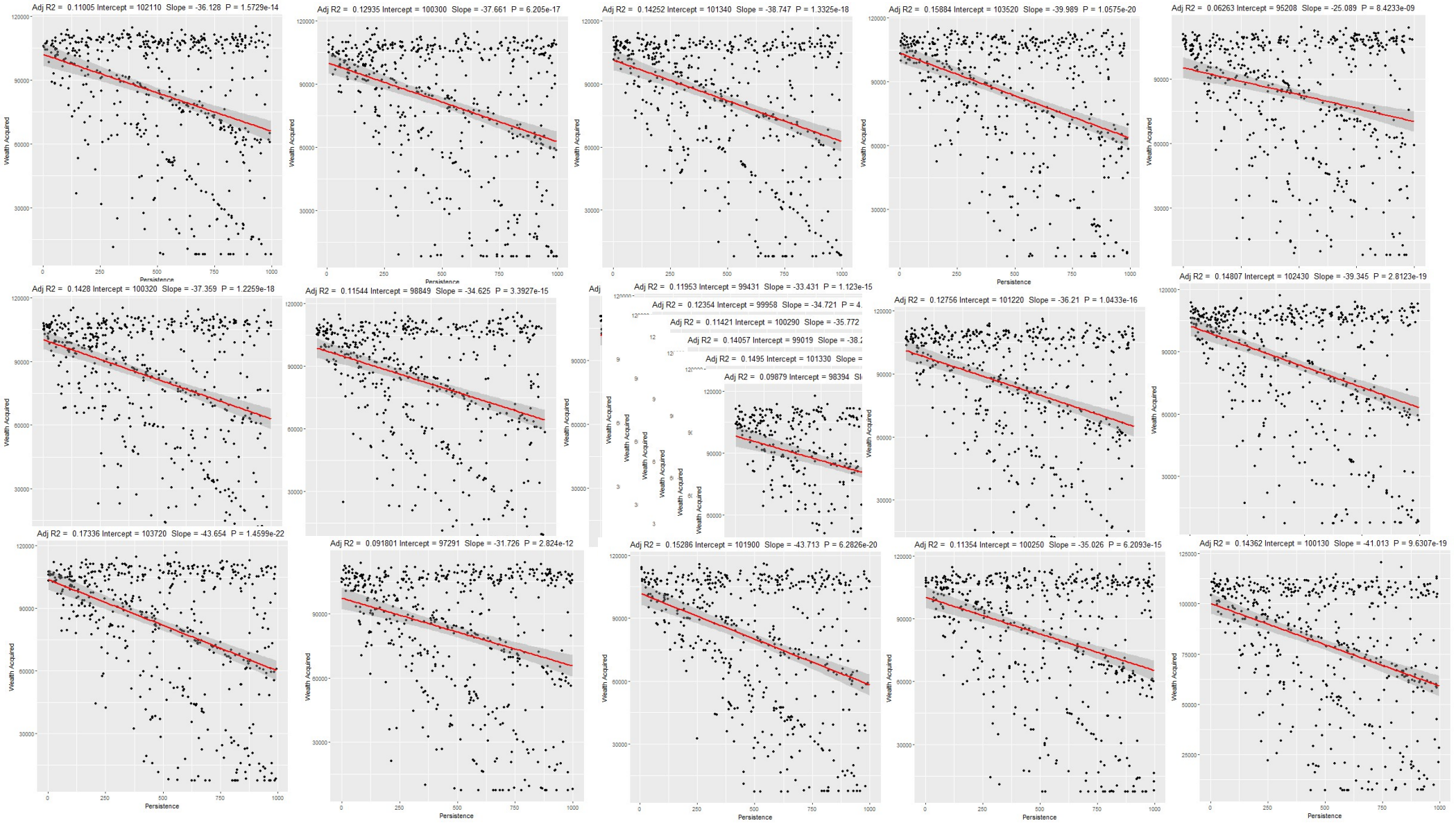




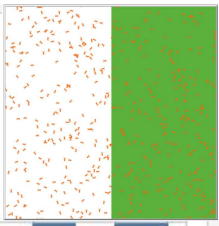
Relationship between Persistence and Wealth Acquired

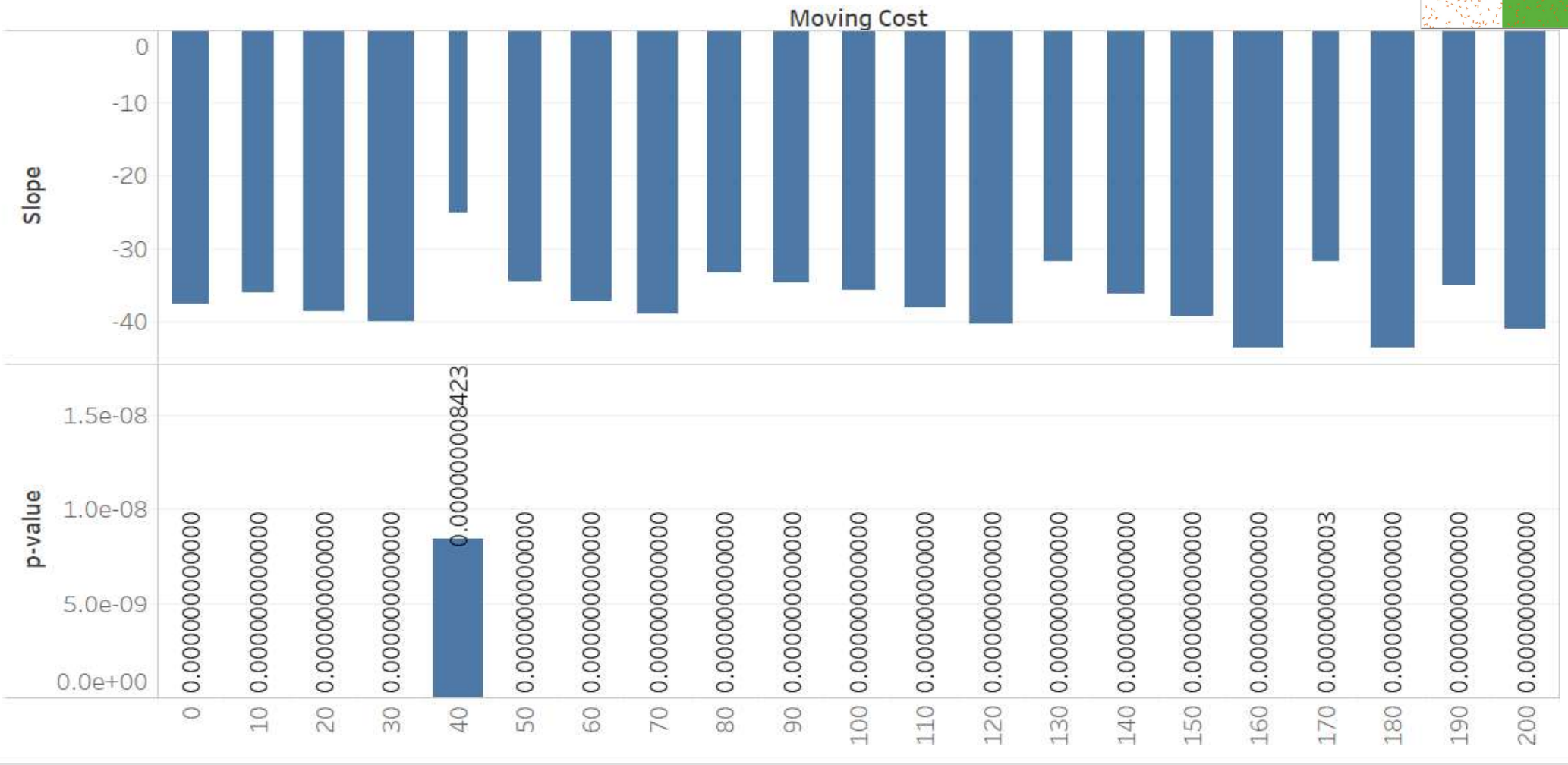
- Resources concentrated in a region, Resources Steady Over Time




Adj R2 = 0.11005 Intercept = 102110 Slope = -36.128 P = 1.5729e-14
Adj R2 = 0.12935 Intercept = 100300 Slope = -37.661 P = 6.205e-17
Adj R2 = 0.14252 Intercept = 101340 Slope = -38.747 P = 1.3325e-18
Adj R2 = 0.15884 Intercept = 103520 Slope = -39.989 P = 1.0575e-20
Adj R2 = 0.06263 Intercept = 95208 Slope = -25.089 P = 8.4233e-09
Adj R2 = 0.1428 Intercept = 100320 Slope = -37.359 P = 1.2259e-18
Adj R2 = 0.11544 Intercept = 98849 Slope = -34.625 P = 3.3927e-15
Adj R2 = 0.11953 Intercept = 99431 Slope = -33.431 P = 1.123e-15
Adj R2 = 0.12354 Intercept = 99958 Slope = -34.721 P = 4.
Adj R2 = 0.11421 Intercept = 100290 Slope = -35.772
Adj R2 = 0.14057 Intercept = 99019 Slope = -38.
Adj R2 = 0.1495 Intercept = 101330 Slope =
Adj R2 = 0.09879 Intercept = 98394 Sl
Adj R2 = 0.12756 Intercept = 101220 Slope = -36.21 P = 1.0433e-16
Adj R2 = 0.14807 Intercept = 102430 Slope = -39.345 P = 2.8123e-19
Adj R2 = 0.17336 Intercept = 103720 Slope = -43.654 P = 1.4599e-22
Adj R2 = 0.091801 Intercept = 97291 Slope = -31.726 P = 2.824e-12
Adj R2 = 0.15286 Intercept = 101900 Slope = -43.713 P = 6.2826e-20
Adj R2 = 0.11354 Intercept = 100250 Slope = -35.026 P = 6.2093e-15
Adj R2 = 0.14362 Intercept = 100130 Slope = -41.013 P = 9.6307e-19
Wealth Acquired
Persistence

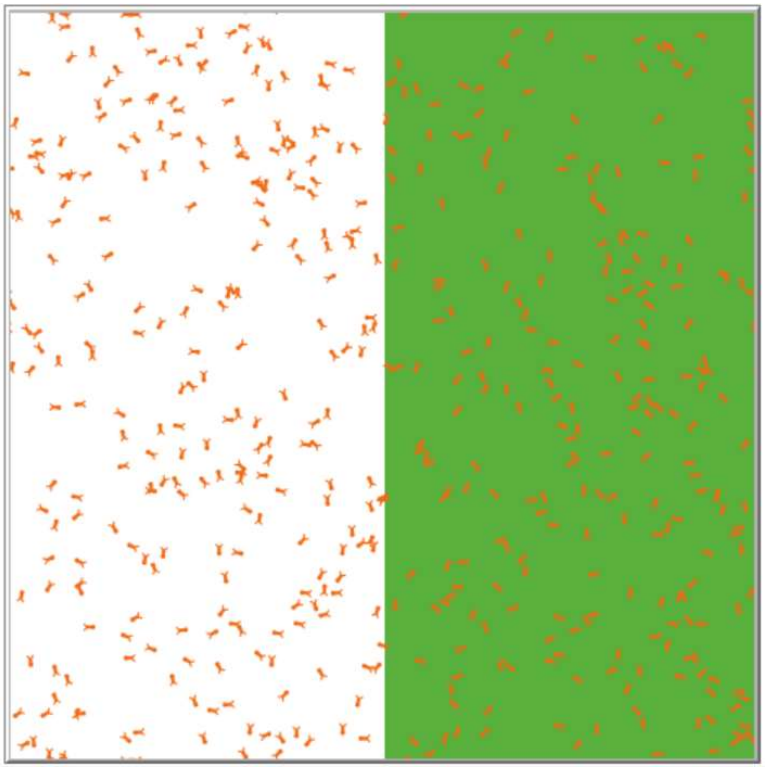
Landscape - Concentrated Resources
Scenario - Resource Availability Constant

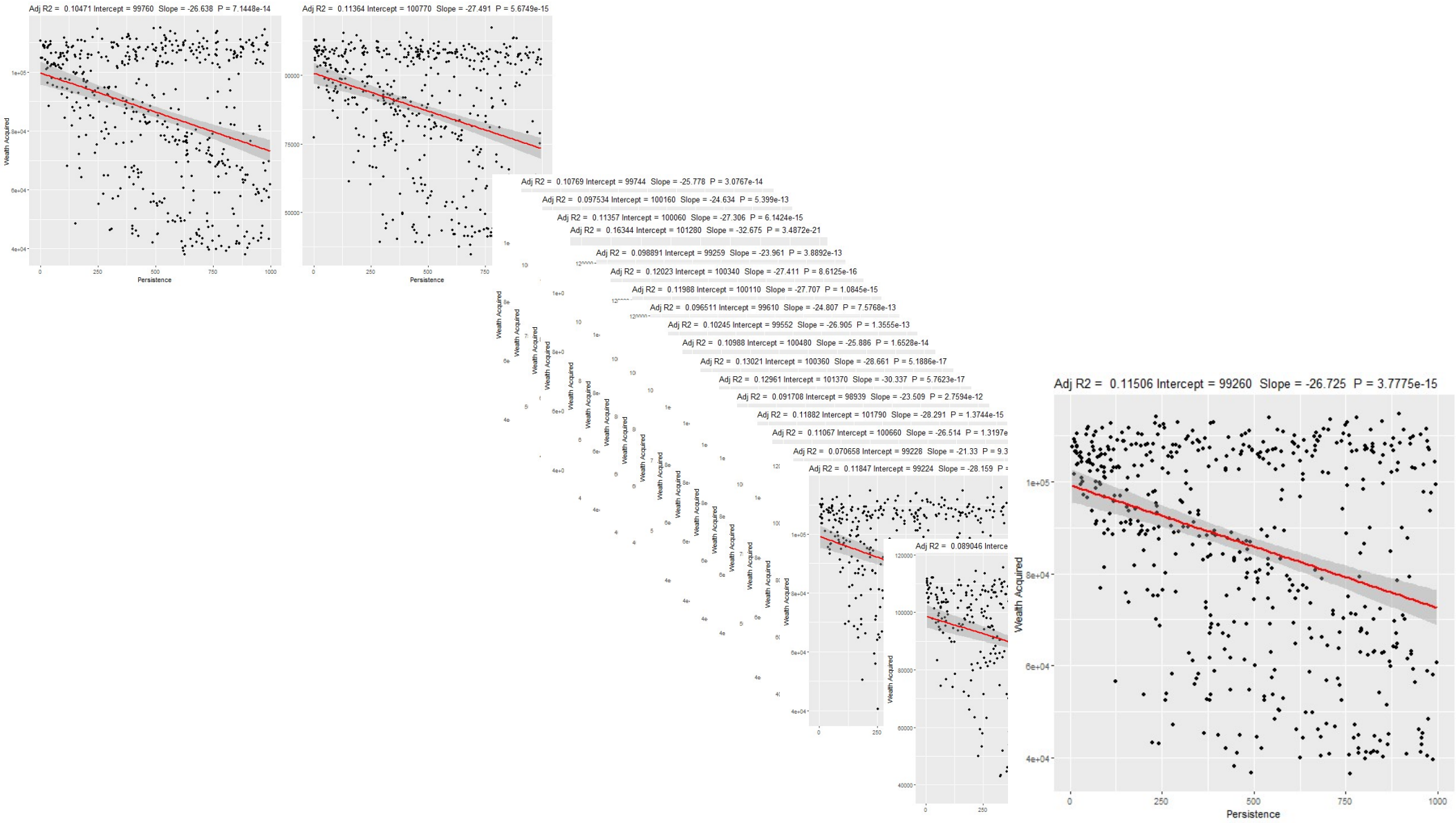


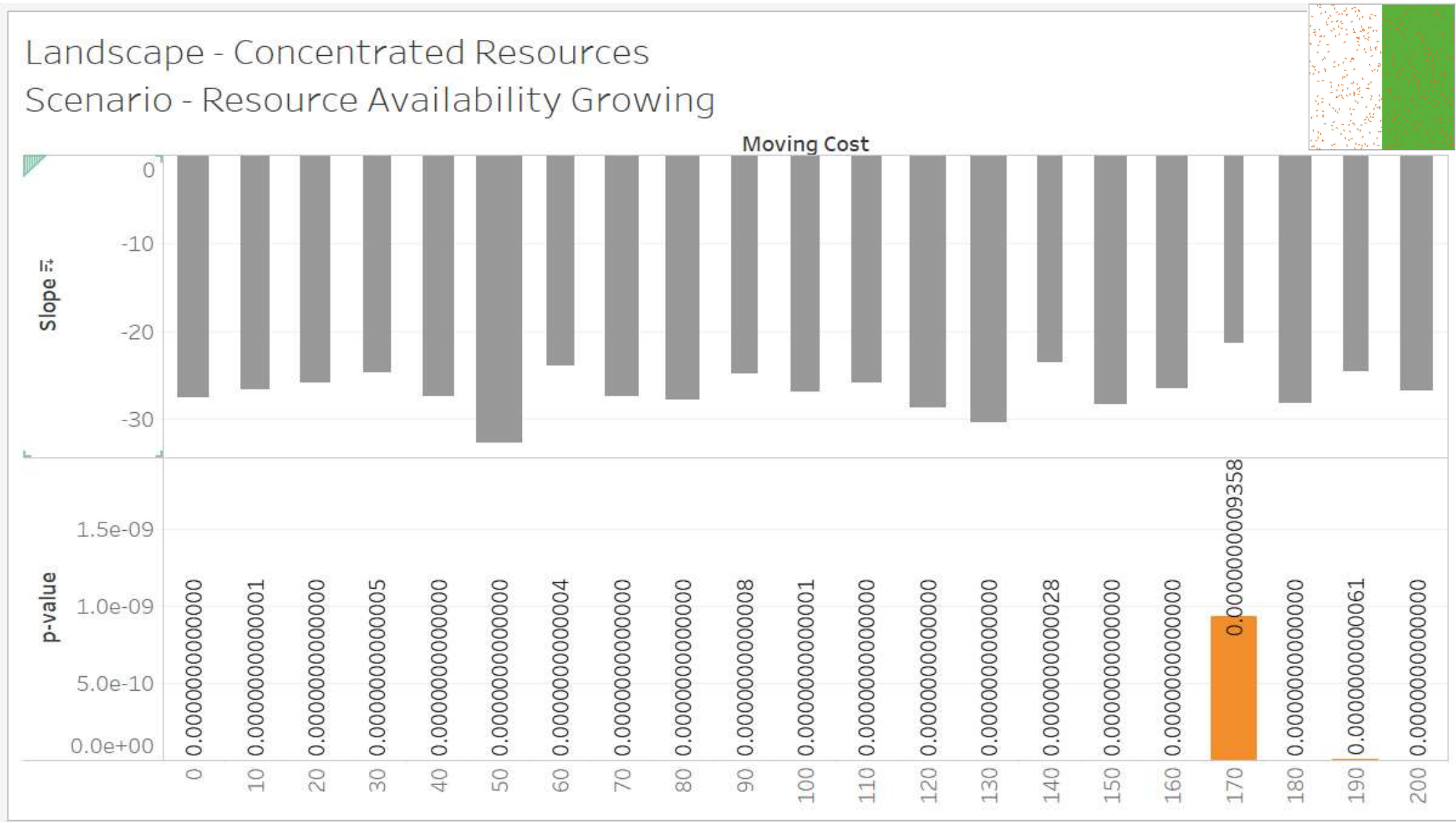


Relationship between Persistence and Wealth Acquired

- Resources concentrated in a region – Resources Growing Over Time

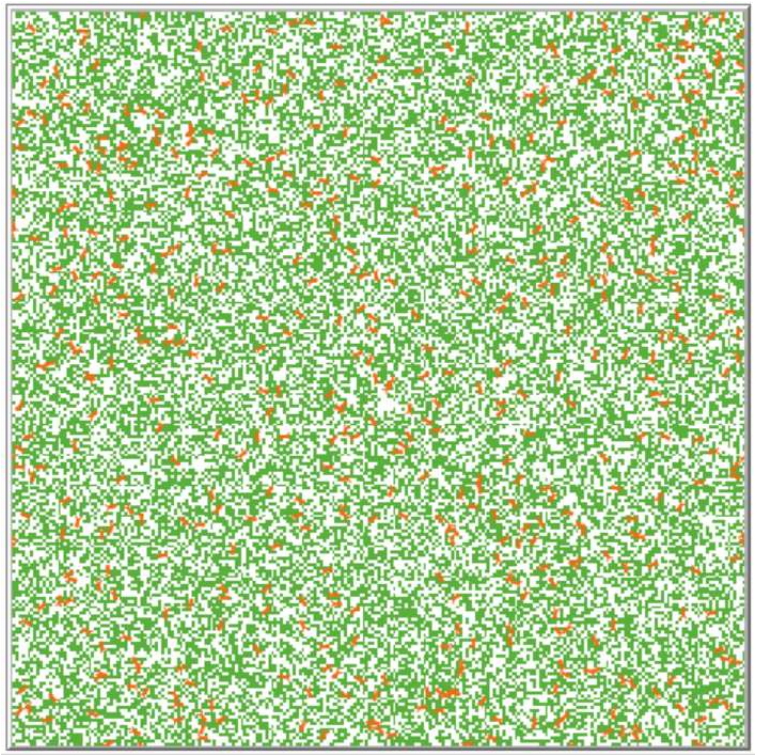


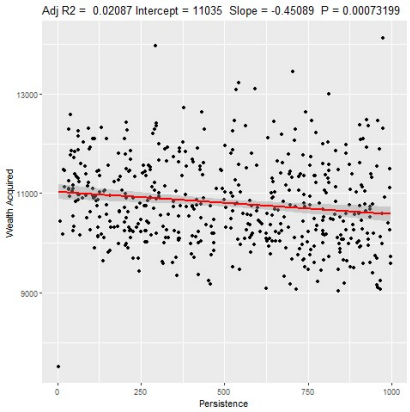

Adj R2 = 0.10471 Intercept = 99760 Slope = -26.638 P = 7.1448e-14
Adj R2 = 0.11364 Intercept = 100770 Slope = -27.491 P = 5.6749e-15
Adj R2 = 0.10769 Intercept = 99744 Slope = -25.778 P = 3.0767e-14
Adj R2 = 0.097534 Intercept = 100160 Slope = -24.634 P = 5.399e-13
Adj R2 = 0.11357 Intercept = 100060 Slope = -27.306 P = 6.1424e-15
Adj R2 = 0.16344 Intercept = 101280 Slope = -32.675 P = 3.4872e-21
Adj R2 = 0.098891 Intercept = 99259 Slope = -23.961 P = 3.8892e-13
Adj R2 = 0.12023 Intercept = 100340 Slope = -27.411 P = 8.6125e-16
Adj R2 = 0.11988 Intercept = 100110 Slope = -27.707 P = 1.0845e-15
Adj R2 = 0.096511 Intercept = 99610 Slope = -24.807 P = 7.5768e-13
Adj R2 = 0.10245 Intercept = 99552 Slope = -26.905 P = 1.3555e-13
Adj R2 = 0.10988 Intercept = 100480 Slope = -25.886 P = 1.6528e-14
Adj R2 = 0.13021 Intercept = 100360 Slope = -28.661 P = 5.1886e-17
Adj R2 = 0.12961 Intercept = 101370 Slope = -30.337 P = 5.7623e-17
Adj R2 = 0.091708 Intercept = 98939 Slope = -23.509 P = 2.7594e-12
Adj R2 = 0.11882 Intercept = 101790 Slope = -28.291 P = 1.3744e-15
Adj R2 = 0.11067 Intercept = 100660 Slope = -26.514 P = 1.3197e
Adj R2 = 0.070658 Intercept = 99228 Slope = -21.33 P = 9.3
Adj R2 = 0.11847 Intercept = 99224 Slope = -28.159 P =
Adj R2 = 0.089046 Interce
Adj R2 = 0.11506 Intercept = 99260 Slope = -26.725 P = 3.7775e-15
Wealth Acquired
Persistence

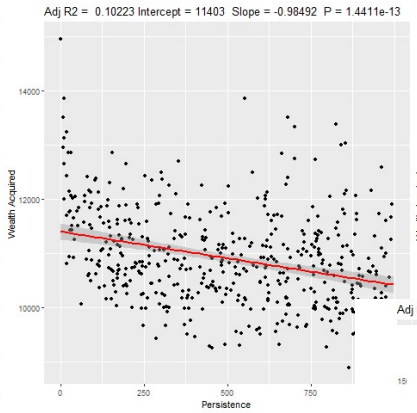

Landscape - Concentrated Resources
Scenario - Resource Availability Growing
Moving Cost
Slope
0
-10
-20
-30
p-value
1.5e-09
1.0e-09
5.0e-10
0.0e+00
0.000000000000
0.000000000001
0.000000000000
0.000000000005
0.000000000000
0.000000000000
0.000000000004
0.000000000000
0.000000000000
0.000000000008
0.000000000001
0.000000000000
0.000000000000
0.000000000000
0.000000000028
0.000000000000
0.000000000000
0.000000009358
0.000000000000
0.000000000061
0.000000000000
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200

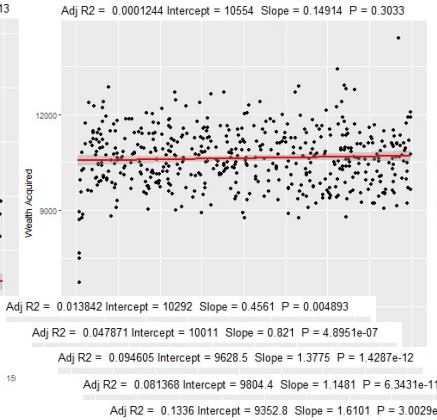
Relationship between Persistence and Wealth Acquired

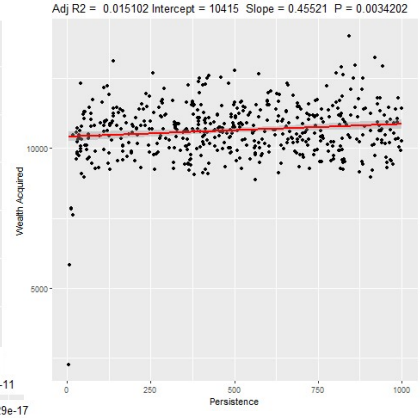
- Resources randomly distributed in a region – Resources declining over time

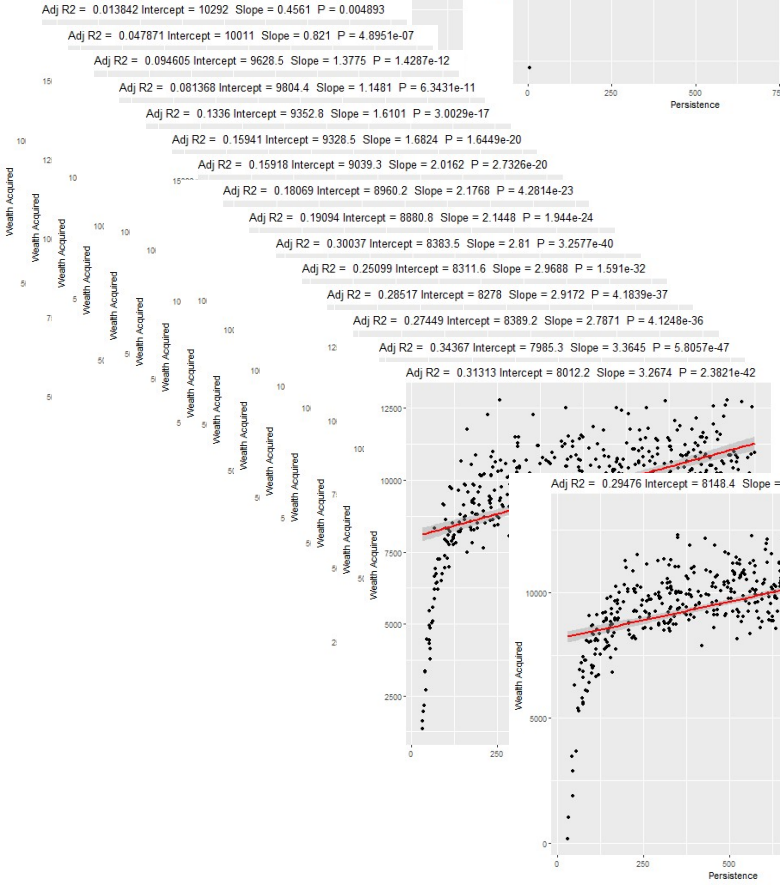


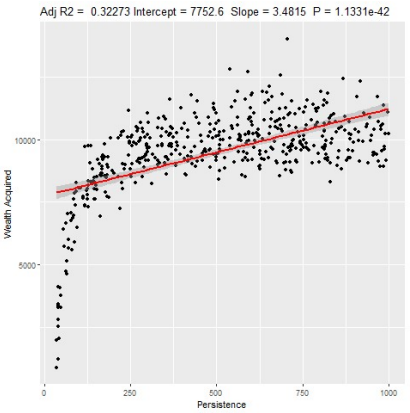

Adj R2 = 0.02087 Intercept = 11035 Slope = -0.45089 P = 0.00073199
Wealth Acquired
Persistence


Adj R2 = 0.10223 Intercept = 11403 Slope = -0.98492 P = 1.4411e-13
Wealth Acquired
Persistence


Adj R2 = 0.0001244 Intercept = 10554 Slope = 0.14914 P = 0.3033
Wealth Acquired

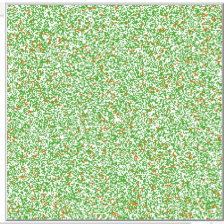

Adj R2 = 0.015102 Intercept = 10415 Slope = 0.45521 P = 0.0034202
Wealth Acquired
Persistence

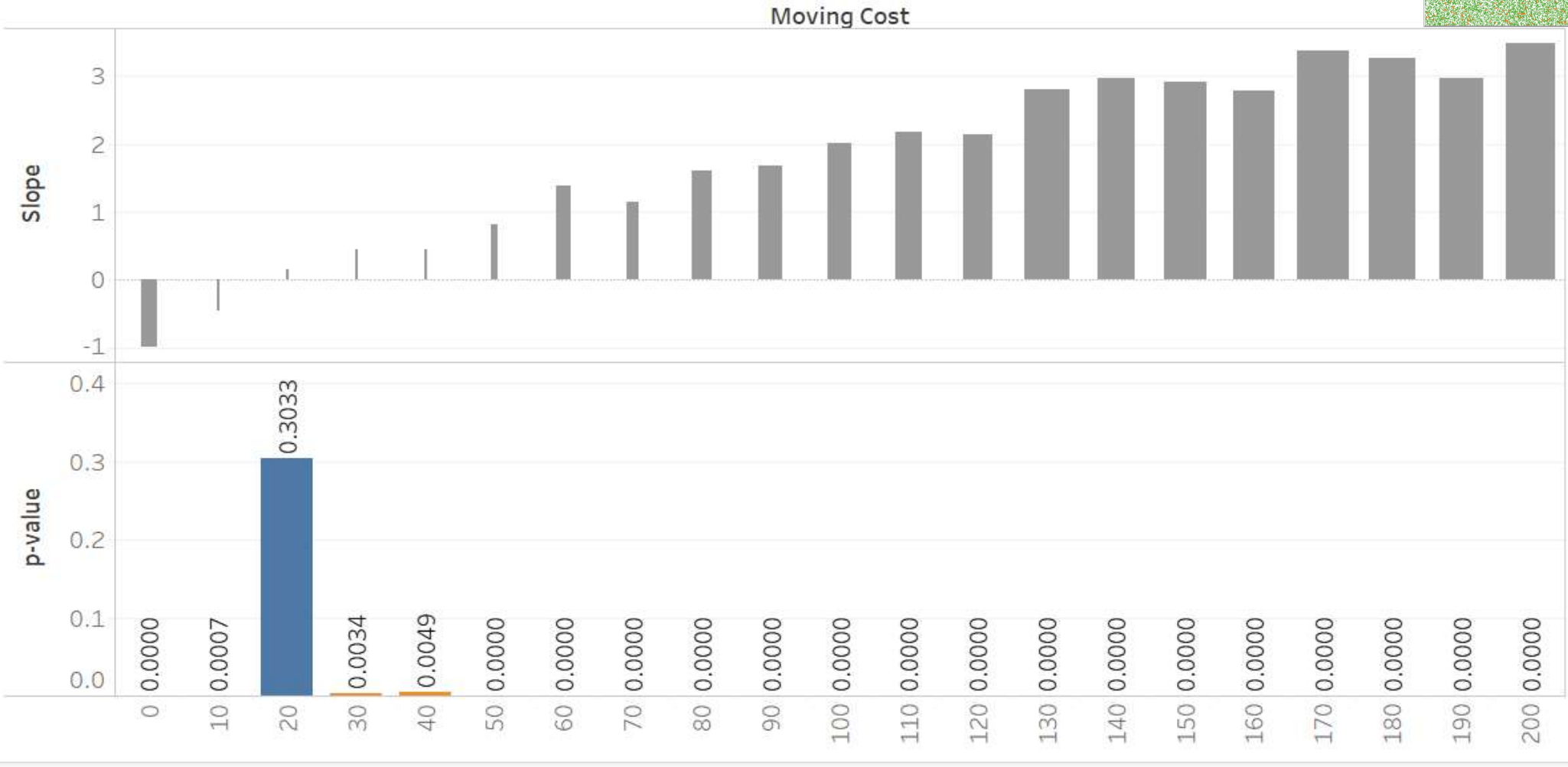

Adj R2 = 0.013842 Intercept = 10292 Slope = 0.4561 P = 0.004893
Adj R2 = 0.047871 Intercept = 10011 Slope = 0.821 P = 4.8951e-07
Adj R2 = 0.094605 Intercept = 9628.5 Slope = 1.3775 P = 1.4287e-12
Adj R2 = 0.081368 Intercept = 9804.4 Slope = 1.1481 P = 6.3431e-11
Adj R2 = 0.1336 Intercept = 9352.8 Slope = 1.6101 P = 3.0029e-17
Adj R2 = 0.15941 Intercept = 9328.5 Slope = 1.6824 P = 1.6449e-20
Adj R2 = 0.15918 Intercept = 9039.3 Slope = 2.0162 P = 2.7326e-20
Adj R2 = 0.18069 Intercept = 8960.2 Slope = 2.1768 P = 4.2814e-23
Adj R2 = 0.19094 Intercept = 8880.8 Slope = 2.1448 P = 1.944e-24
Adj R2 = 0.30037 Intercept = 8383.5 Slope = 2.81 P = 3.2577e-40
Adj R2 = 0.25099 Intercept = 8311.6 Slope = 2.9688 P = 1.591e-32
Adj R2 = 0.28517 Intercept = 8278 Slope = 2.9172 P = 4.1839e-37
Adj R2 = 0.27449 Intercept = 8389.2 Slope = 2.7871 P = 4.1248e-36
Adj R2 = 0.34367 Intercept = 7985.3 Slope = 3.3645 P = 5.8057e-47
Adj R2 = 0.31313 Intercept = 8012.2 Slope = 3.2674 P = 2.3821e-42
Adj R2 = 0.29476 Intercept = 8148.4 Slope = 2.9687 P = 1.1326e-38
Wealth Acquired
Persistence


Adj R2 = 0.32273 Intercept = 7752.6 Slope = 3.4815 P = 1.1331e-42
Wealth Acquired
Persistence

Landscape - Randomly Distributed Resources

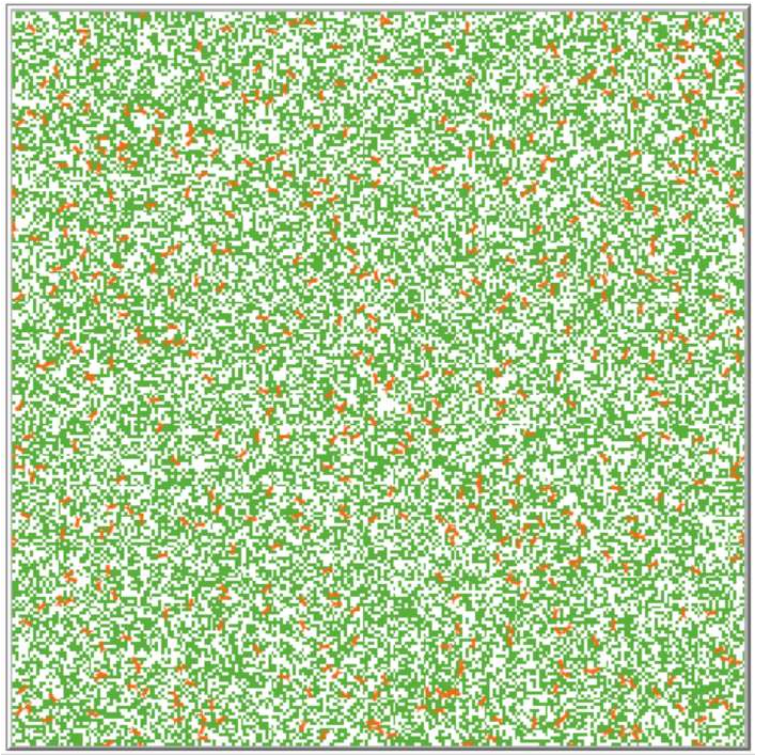
Scenario - Declining Resources

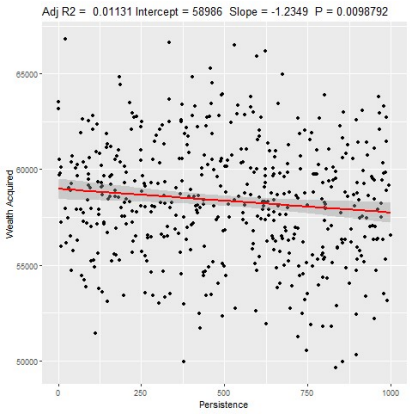


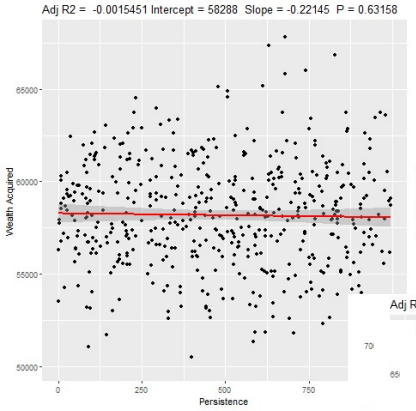


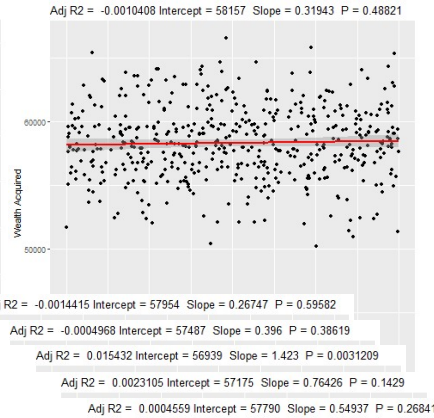
Relationship between Persistence and Wealth Acquired

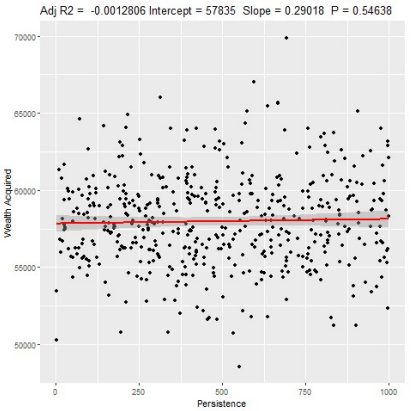
- Resources randomly distributed in a region – Resources steady over time

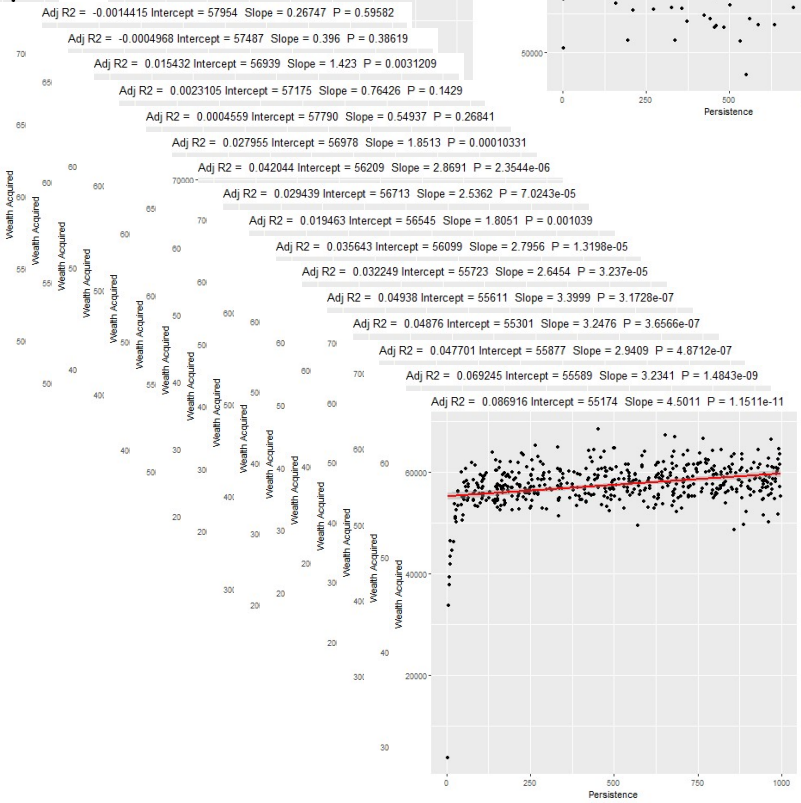


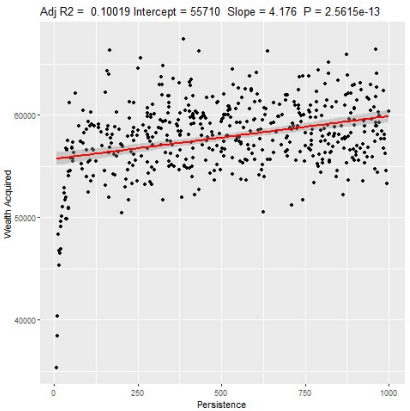

Adj R2 = 0.01131 Intercept = 58986 Slope = -1.2349 P = 0.0098792
Wealth Acquired
Persistence


Adj R2 = -0.0015451 Intercept = 58288 Slope = -0.22145 P = 0.63158
Wealth Acquired
Persistence

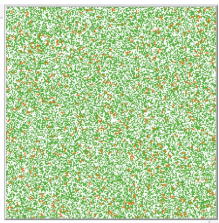

Adj R2 = -0.0010408 Intercept = 58157 Slope = 0.31943 P = 0.48821
Wealth Acquired


Adj R2 = -0.0012806 Intercept = 57835 Slope = 0.29018 P = 0.54638
Wealth Acquired
Persistence


Adj R2 = -0.0014415 Intercept = 57954 Slope = 0.26747 P = 0.59582
Adj R2 = -0.0004968 Intercept = 57487 Slope = 0.396 P = 0.38619
Adj R2 = 0.015432 Intercept = 56939 Slope = 1.423 P = 0.0031209
Adj R2 = 0.0023105 Intercept = 57175 Slope = 0.76426 P = 0.1429
Adj R2 = 0.0004559 Intercept = 57790 Slope = 0.54937 P = 0.26841
Adj R2 = 0.027955 Intercept = 56978 Slope = 1.8513 P = 0.00010331
Adj R2 = 0.042044 Intercept = 56209 Slope = 2.8691 P = 2.3544e-06
Adj R2 = 0.029439 Intercept = 56713 Slope = 2.5362 P = 7.0243e-05
Adj R2 = 0.019463 Intercept = 56545 Slope = 1.8051 P = 0.001039
Adj R2 = 0.035643 Intercept = 56099 Slope = 2.7956 P = 1.3198e-05
Adj R2 = 0.032249 Intercept = 55723 Slope = 2.6454 P = 3.237e-05
Adj R2 = 0.04938 Intercept = 55611 Slope = 3.3999 P = 3.1728e-07
Adj R2 = 0.04876 Intercept = 55301 Slope = 3.2476 P = 3.6566e-07
Adj R2 = 0.047701 Intercept = 55877 Slope = 2.9409 P = 4.8712e-07
Adj R2 = 0.069245 Intercept = 55589 Slope = 3.2341 P = 1.4843e-09
Adj R2 = 0.086916 Intercept = 55174 Slope = 4.5011 P = 1.1511e-11
Wealth Acquired
Persistence

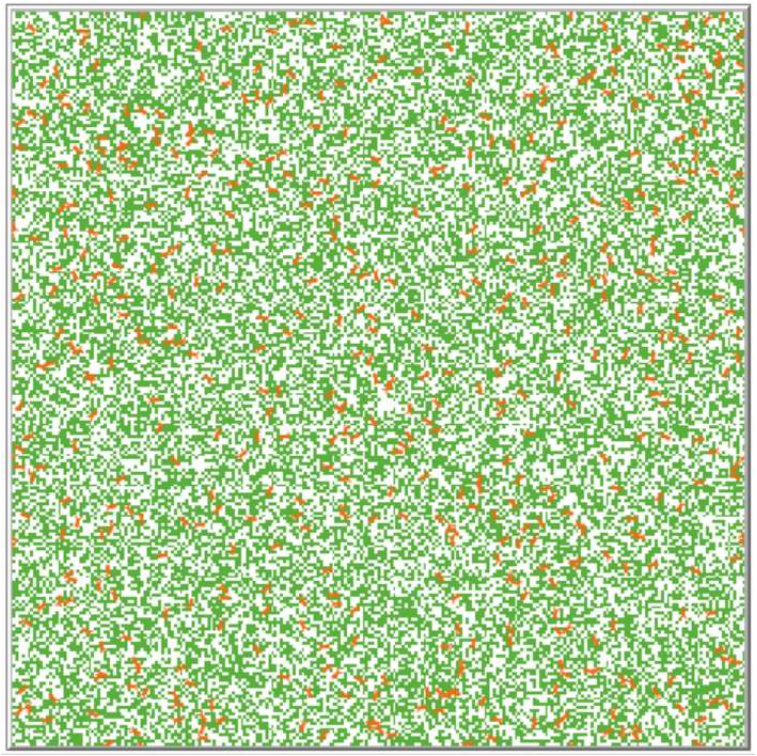

Adj R2 = 0.10019 Intercept = 55710 Slope = 4.176 P = 2.5615e-13
Wealth Acquired
Persistence

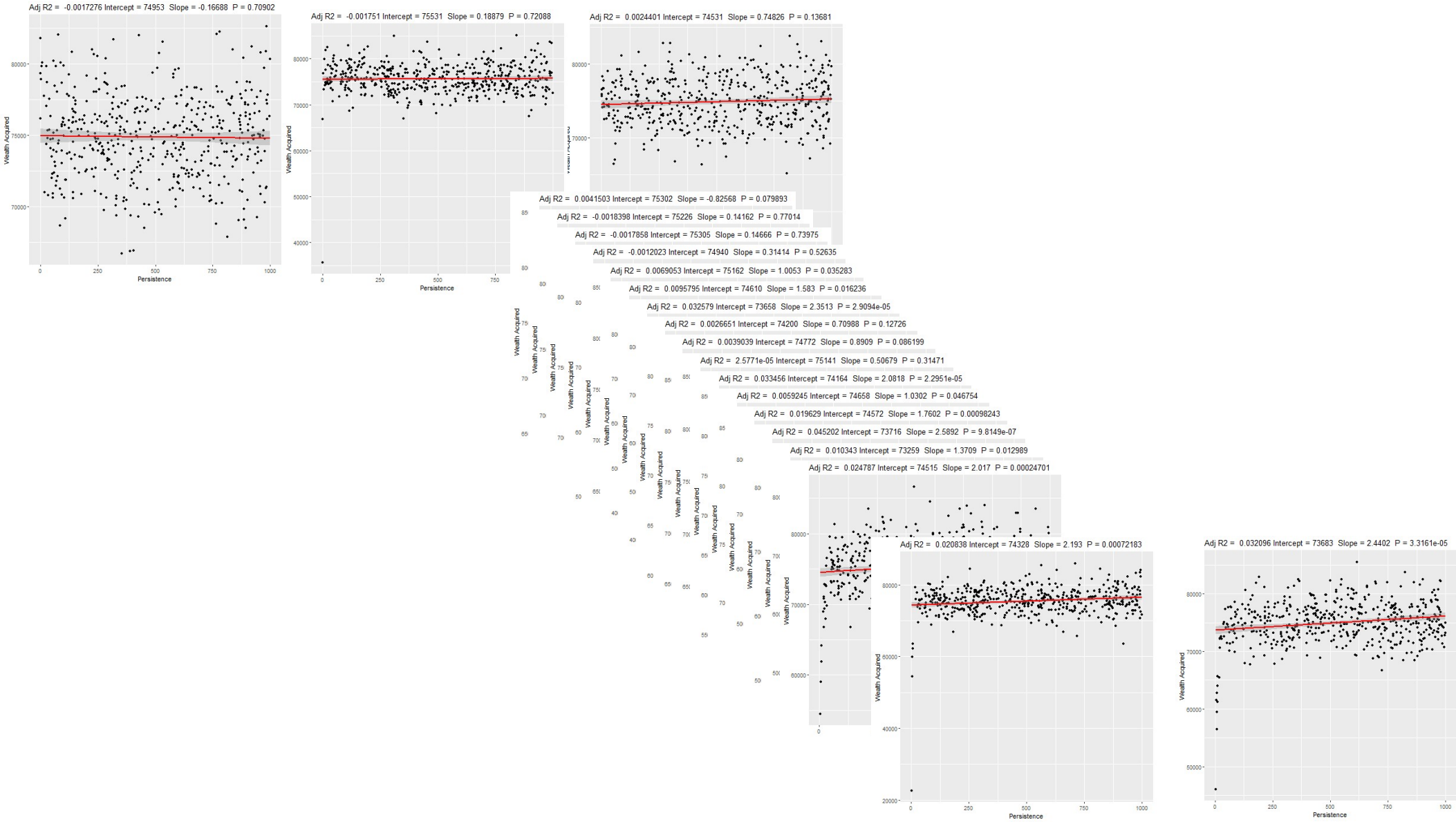
Landscape - Randomly Distributed Resources
Scenario - Resource Availability Constant



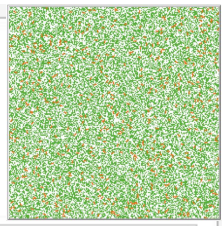
Relationship between Persistence and Wealth Acquired

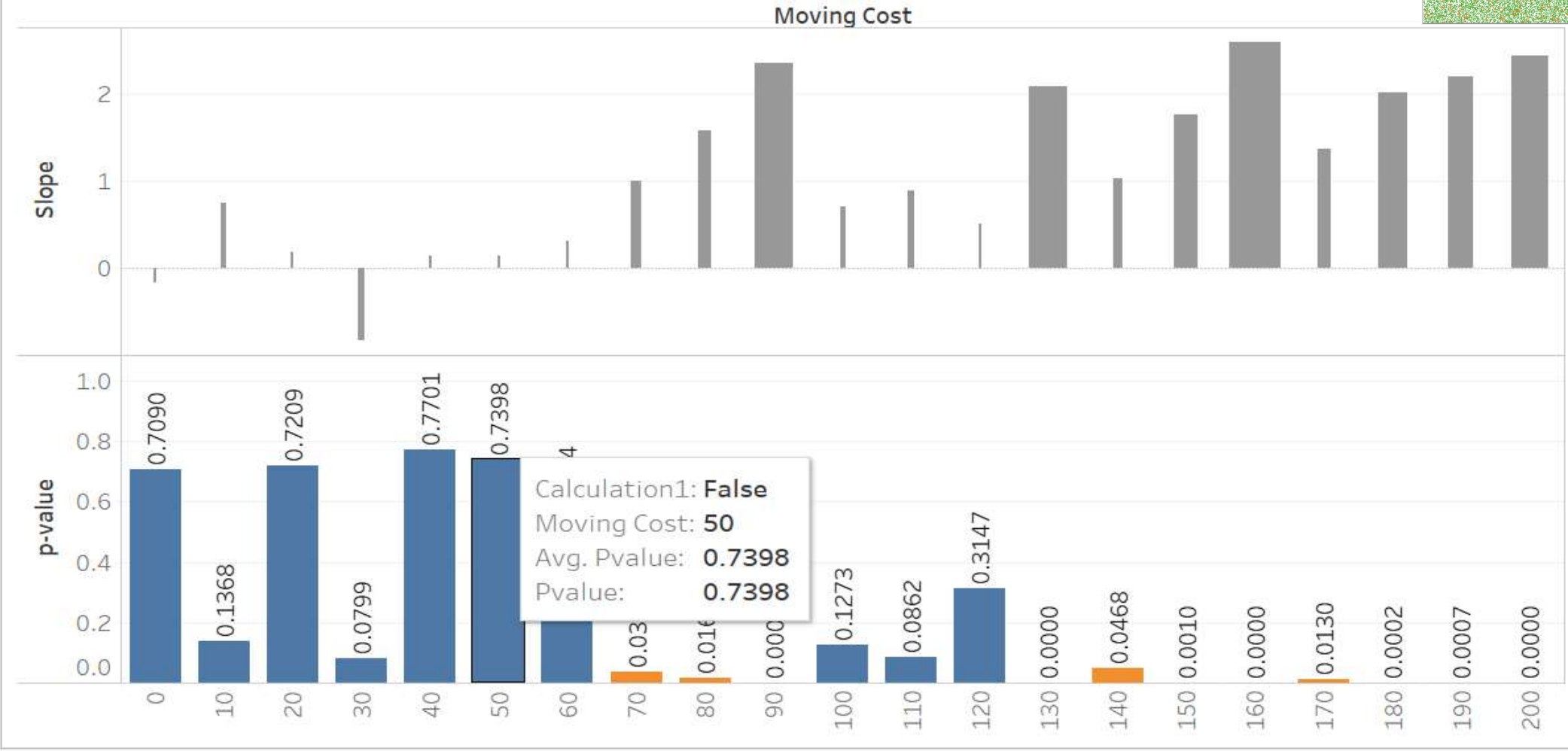
- Resources randomly distributed in a region – Resources growing over time




Adj R2 = -0.0017276 Intercept = 74953 Slope = -0.16688 P = 0.70902
Adj R2 = -0.001751 Intercept = 75531 Slope = 0.18879 P = 0.72088
Adj R2 = 0.0024401 Intercept = 74531 Slope = 0.74826 P = 0.13681
Adj R2 = 0.0041503 Intercept = 75302 Slope = -0.82568 P = 0.079893
Adj R2 = -0.0018398 Intercept = 75226 Slope = 0.14162 P = 0.77014
Adj R2 = -0.0017858 Intercept = 75305 Slope = 0.14666 P = 0.73975
Adj R2 = -0.0012023 Intercept = 74940 Slope = 0.31414 P = 0.52635
Adj R2 = 0.0069053 Intercept = 75162 Slope = 1.0053 P = 0.035283
Adj R2 = 0.0095795 Intercept = 74610 Slope = 1.583 P = 0.016236
Adj R2 = 0.032579 Intercept = 73658 Slope = 2.3513 P = 2.9094e-05
Adj R2 = 0.0026651 Intercept = 74200 Slope = 0.70988 P = 0.12726
Adj R2 = 0.0039039 Intercept = 74772 Slope = 0.8909 P = 0.086199
Adj R2 = 2.5771e-05 Intercept = 75141 Slope = 0.50679 P = 0.31471
Adj R2 = 0.033456 Intercept = 74164 Slope = 2.0818 P = 2.2951e-05
Adj R2 = 0.0059245 Intercept = 74658 Slope = 1.0302 P = 0.046754
Adj R2 = 0.019629 Intercept = 74572 Slope = 1.7602 P = 0.00098243
Adj R2 = 0.045202 Intercept = 73716 Slope = 2.5892 P = 9.8149e-07
Adj R2 = 0.010343 Intercept = 73259 Slope = 1.3709 P = 0.012989
Adj R2 = 0.024787 Intercept = 74515 Slope = 2.017 P = 0.00024701
Adj R2 = 0.020838 Intercept = 74328 Slope = 2.193 P = 0.00072183
Adj R2 = 0.032096 Intercept = 73683 Slope = 2.4402 P = 3.3161e-05
Wealth Acquired
Persistence

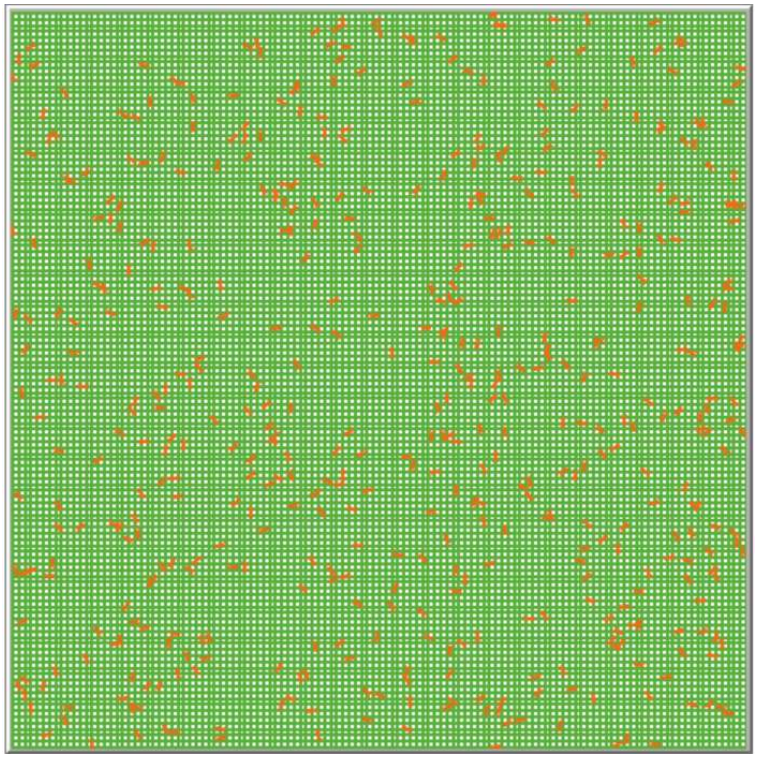
Landscape - Randomly Distributed Resources
Scenario - Resource Availability Growing

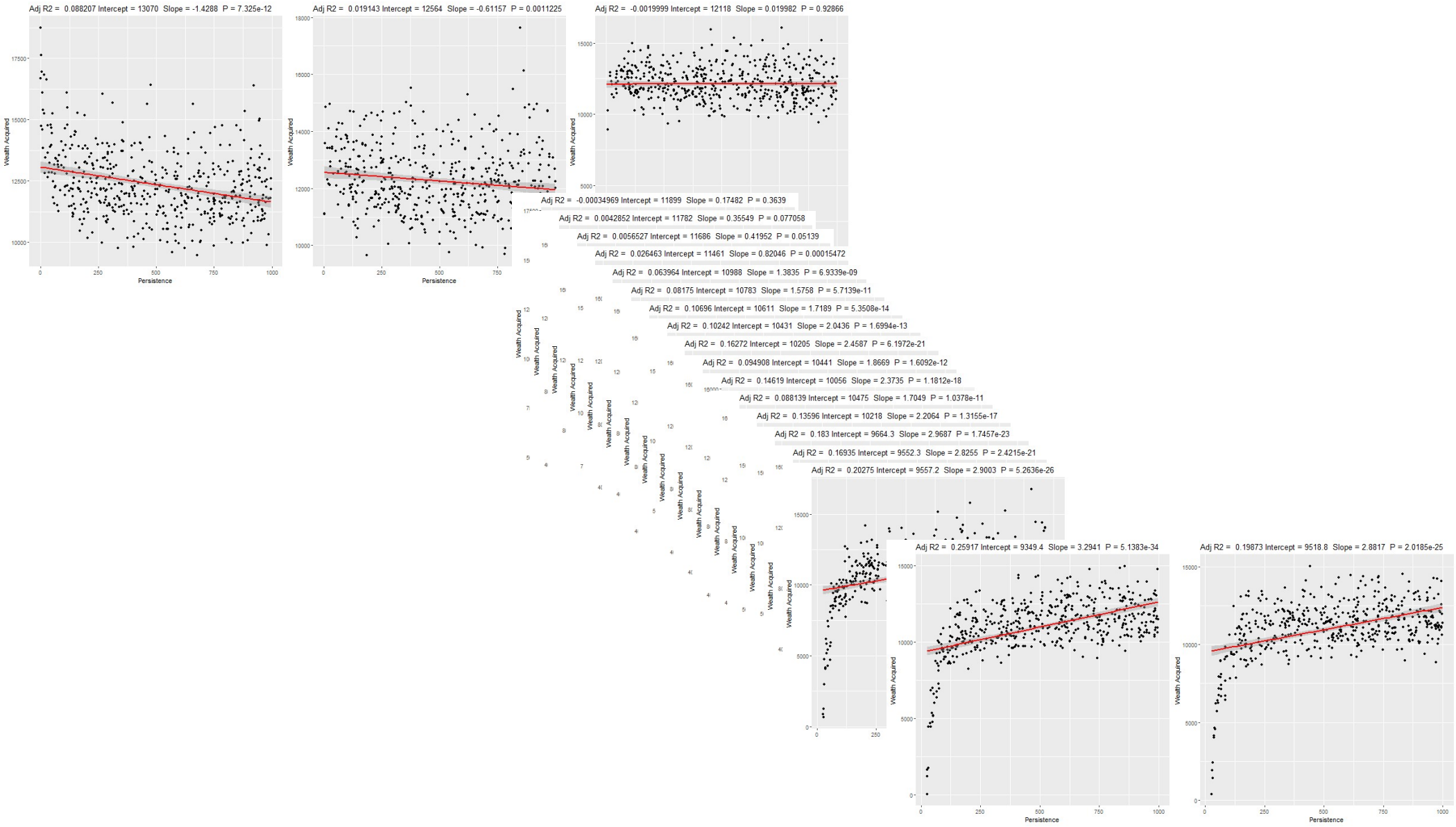


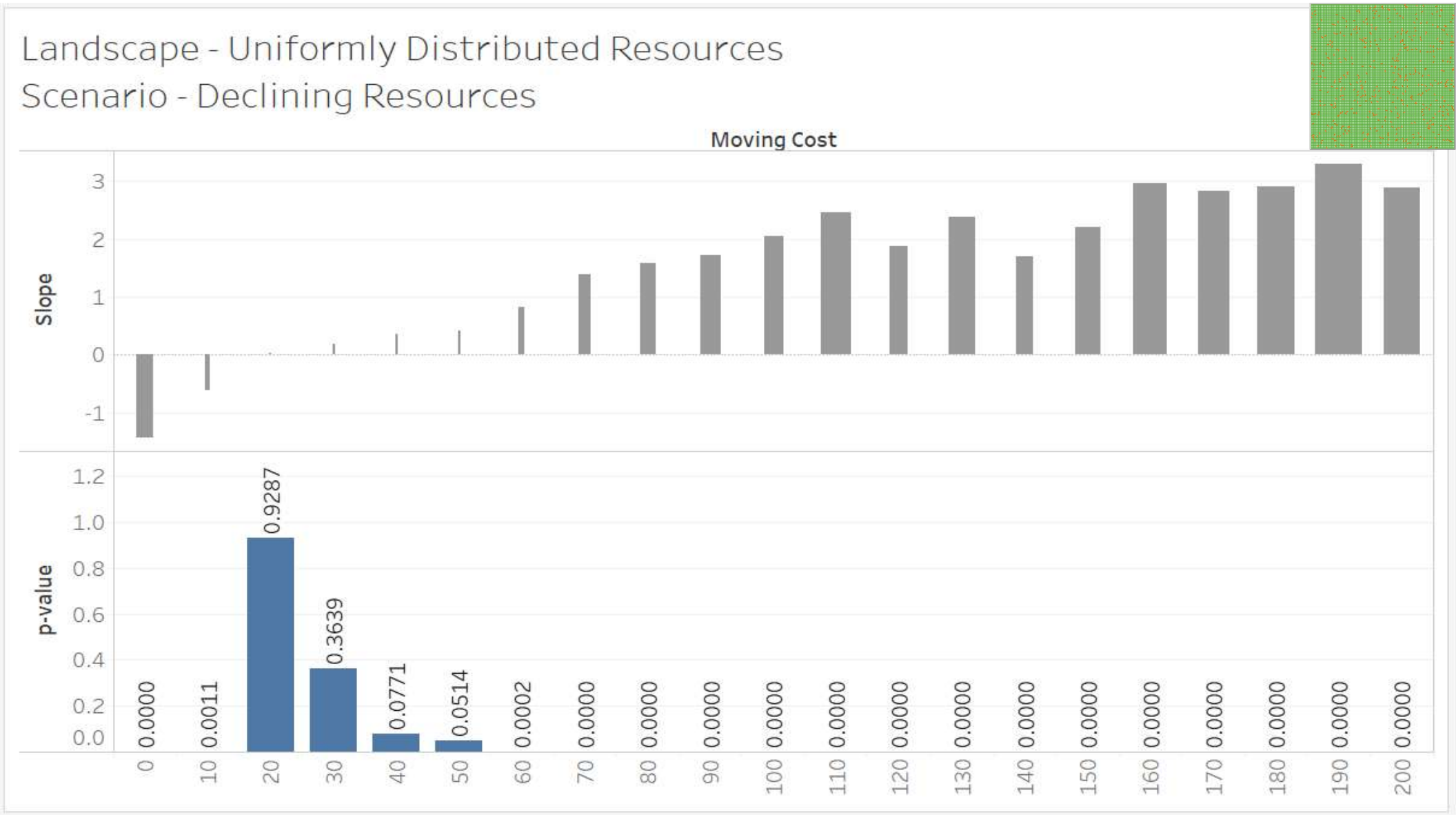


Relationship between Persistence and Wealth Acquired

- Resources uniformly distributed in a region – Resources declining over time

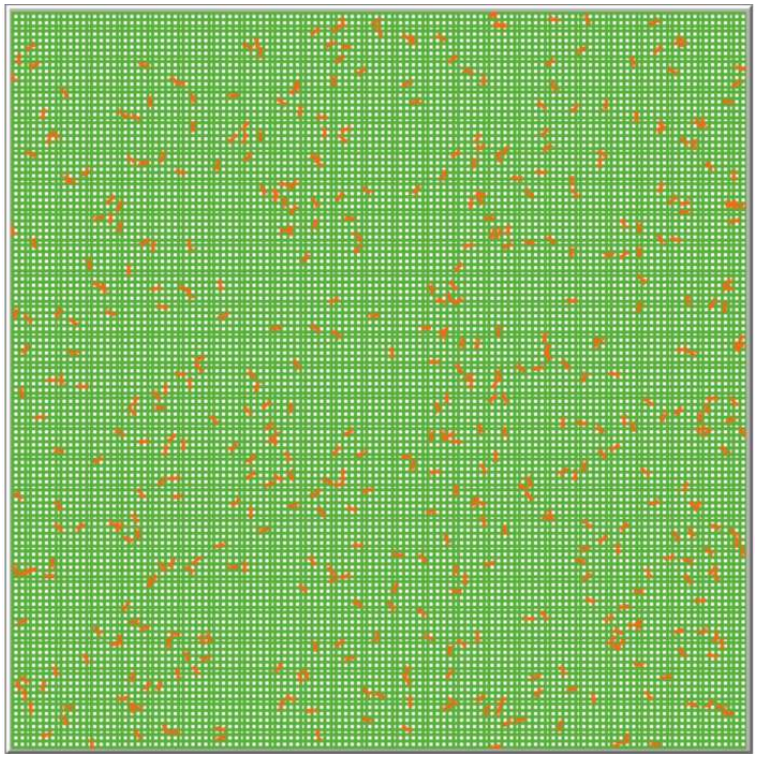


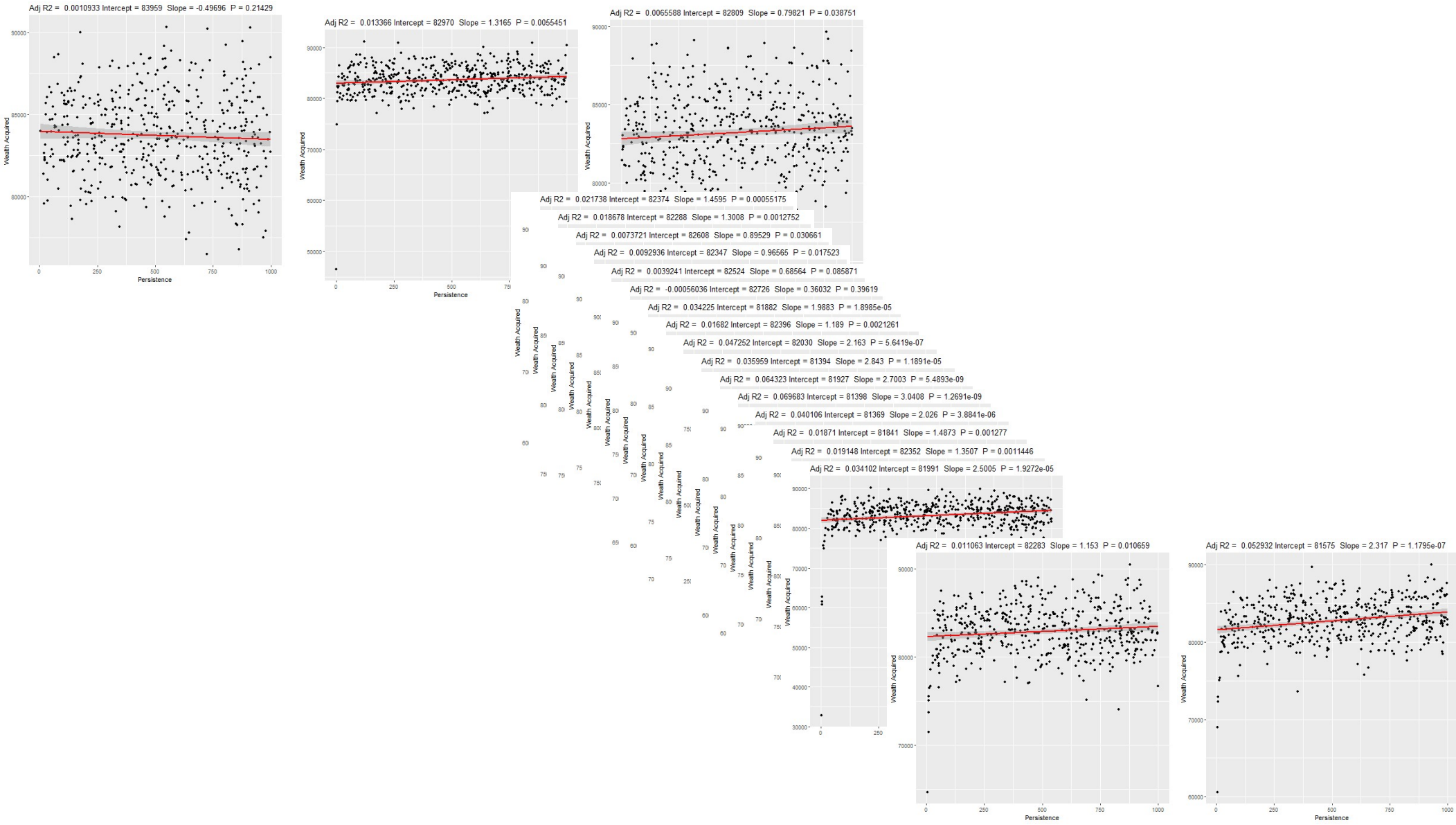

Adj R2 = 0.088207 Intercept = 13070 Slope = -1.4288 P = 7.325e-12
Adj R2 = 0.019143 Intercept = 12564 Slope = -0.61157 P = 0.0011225
Adj R2 = -0.0019999 Intercept = 12118 Slope = 0.019982 P = 0.92866
Adj R2 = -0.00034969 Intercept = 11899 Slope = 0.17482 P = 0.3639
Adj R2 = 0.0042852 Intercept = 11782 Slope = 0.35549 P = 0.077058
Adj R2 = 0.0056527 Intercept = 11686 Slope = 0.41952 P = 0.05139
Adj R2 = 0.026463 Intercept = 11461 Slope = 0.82046 P = 0.00015472
Adj R2 = 0.063964 Intercept = 10988 Slope = 1.3835 P = 6.9339e-09
Adj R2 = 0.08175 Intercept = 10783 Slope = 1.5758 P = 5.7139e-11
Adj R2 = 0.10696 Intercept = 10611 Slope = 1.7189 P = 5.3508e-14
Adj R2 = 0.10242 Intercept = 10431 Slope = 2.0436 P = 1.6994e-13
Adj R2 = 0.16272 Intercept = 10205 Slope = 2.4587 P = 6.1972e-21
Adj R2 = 0.094908 Intercept = 10441 Slope = 1.8669 P = 1.6092e-12
Adj R2 = 0.14619 Intercept = 10056 Slope = 2.3735 P = 1.1812e-18
Adj R2 = 0.088139 Intercept = 10475 Slope = 1.7049 P = 1.0378e-11
Adj R2 = 0.13596 Intercept = 10218 Slope = 2.2064 P = 1.3155e-17
Adj R2 = 0.183 Intercept = 9664.3 Slope = 2.9687 P = 1.7457e-23
Adj R2 = 0.16935 Intercept = 9552.3 Slope = 2.8255 P = 2.4215e-21
Adj R2 = 0.20275 Intercept = 9557.2 Slope = 2.9003 P = 5.2636e-26
Adj R2 = 0.25917 Intercept = 9349.4 Slope = 3.2941 P = 5.1383e-34
Adj R2 = 0.19873 Intercept = 9518.8 Slope = 2.8817 P = 2.0185e-25
Wealth Acquired
Persistence

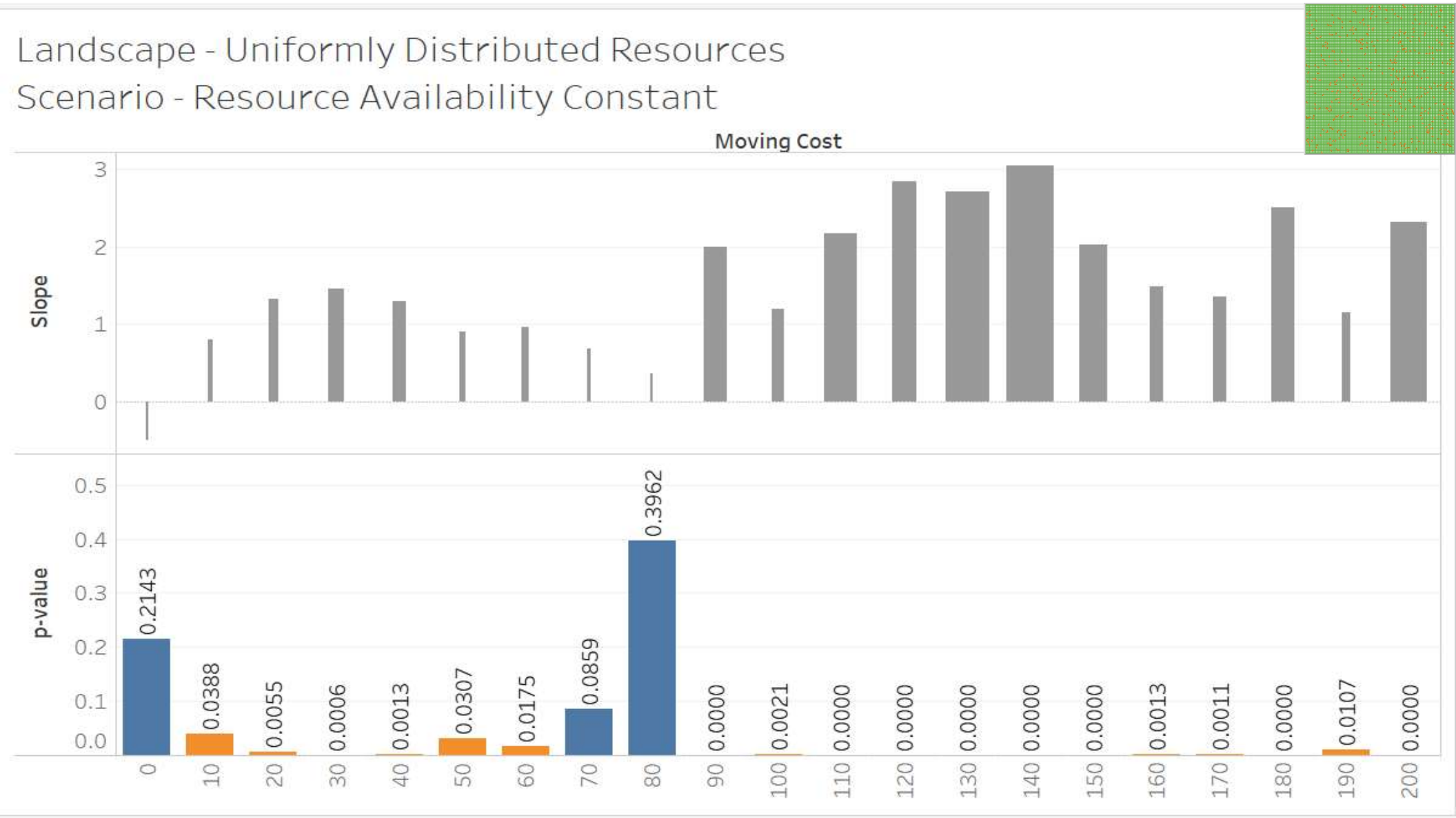

Landscape - Uniformly Distributed Resources
Scenario - Declining Resources
Moving Cost
Slope
3
2
1
0
-1
p-value
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0.0000
0.0011
0.9287
0.3639
0.0771
0.0514
0.0002
0.0000
0.0000
0.0000
0.0000
0.0000
0.0000
0.0000
0.0000
0.0000
0.0000
0.0000
0.0000
0.0000
0.0000
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200

Relationship between Persistence and Wealth Acquired

- Resources uniformly distributed in a region – Resources steady over time

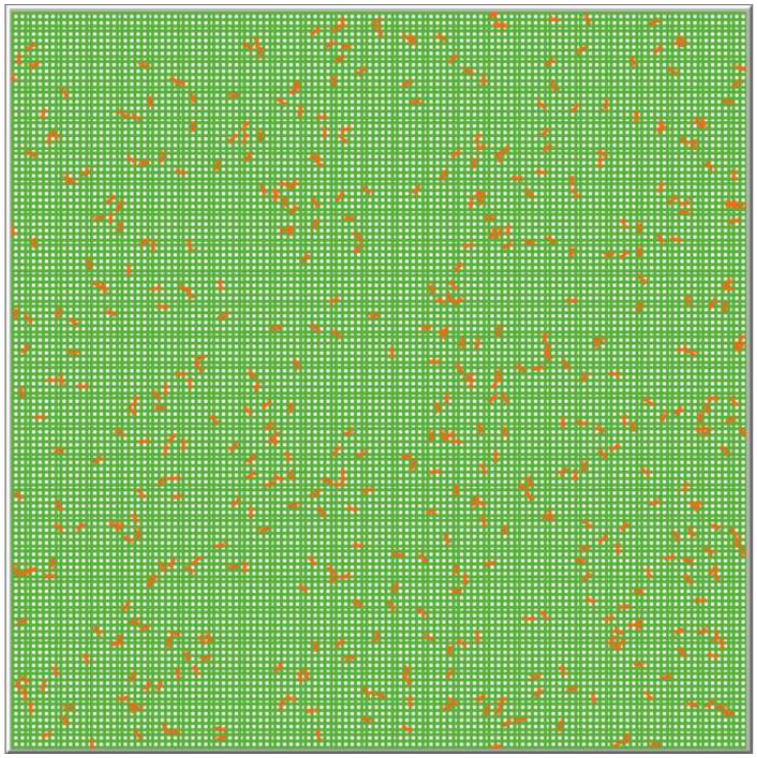


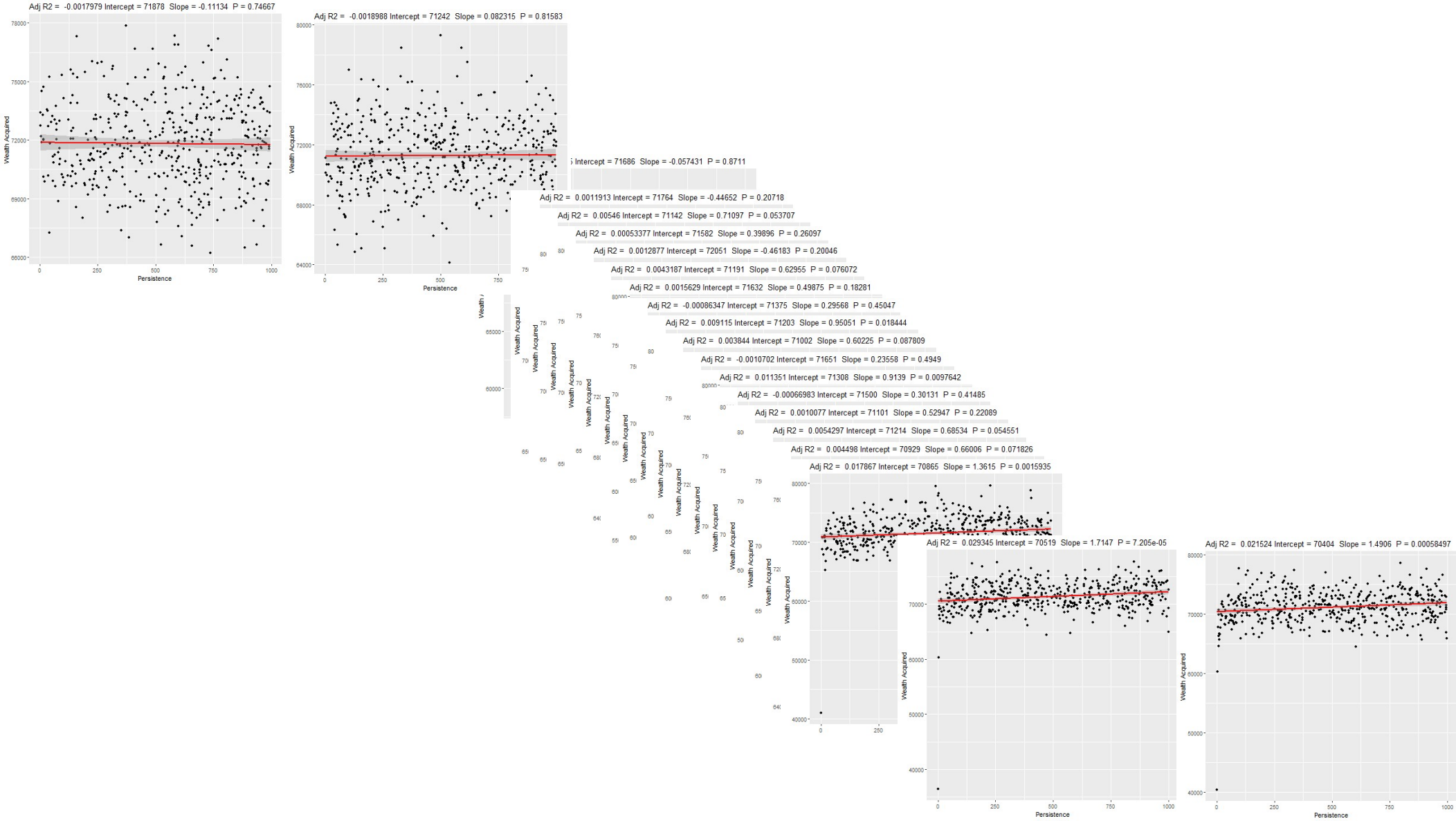

Adj R2 = 0.0010933 Intercept = 83959 Slope = -0.49696 P = 0.21429
Adj R2 = 0.013366 Intercept = 82970 Slope = 1.3165 P = 0.0055451
Adj R2 = 0.0065588 Intercept = 82809 Slope = 0.79821 P = 0.038751
Adj R2 = 0.021738 Intercept = 82374 Slope = 1.4595 P = 0.00055175
Adj R2 = 0.018678 Intercept = 82288 Slope = 1.3008 P = 0.0012752
Adj R2 = 0.0073721 Intercept = 82608 Slope = 0.89529 P = 0.030661
Adj R2 = 0.0092936 Intercept = 82347 Slope = 0.96565 P = 0.017523
Adj R2 = 0.0039241 Intercept = 82524 Slope = 0.68564 P = 0.085871
Adj R2 = -0.00056036 Intercept = 82726 Slope = 0.36032 P = 0.39619
Adj R2 = 0.034225 Intercept = 81882 Slope = 1.9883 P = 1.8985e-05
Adj R2 = 0.01682 Intercept = 82396 Slope = 1.189 P = 0.0021261
Adj R2 = 0.047252 Intercept = 82030 Slope = 2.163 P = 5.6419e-07
Adj R2 = 0.035959 Intercept = 81394 Slope = 2.843 P = 1.1891e-05
Adj R2 = 0.064323 Intercept = 81927 Slope = 2.7003 P = 5.4893e-09
Adj R2 = 0.069683 Intercept = 81398 Slope = 3.0408 P = 1.2691e-09
Adj R2 = 0.040106 Intercept = 81369 Slope = 2.026 P = 3.8841e-06
Adj R2 = 0.01871 Intercept = 81841 Slope = 1.4873 P = 0.001277
Adj R2 = 0.019148 Intercept = 82352 Slope = 1.3507 P = 0.0011446
Adj R2 = 0.034102 Intercept = 81991 Slope = 2.5005 P = 1.9272e-05
Adj R2 = 0.011063 Intercept = 82283 Slope = 1.153 P = 0.010659
Adj R2 = 0.052932 Intercept = 81575 Slope = 2.317 P = 1.1795e-07
Wealth Acquired
Persistence

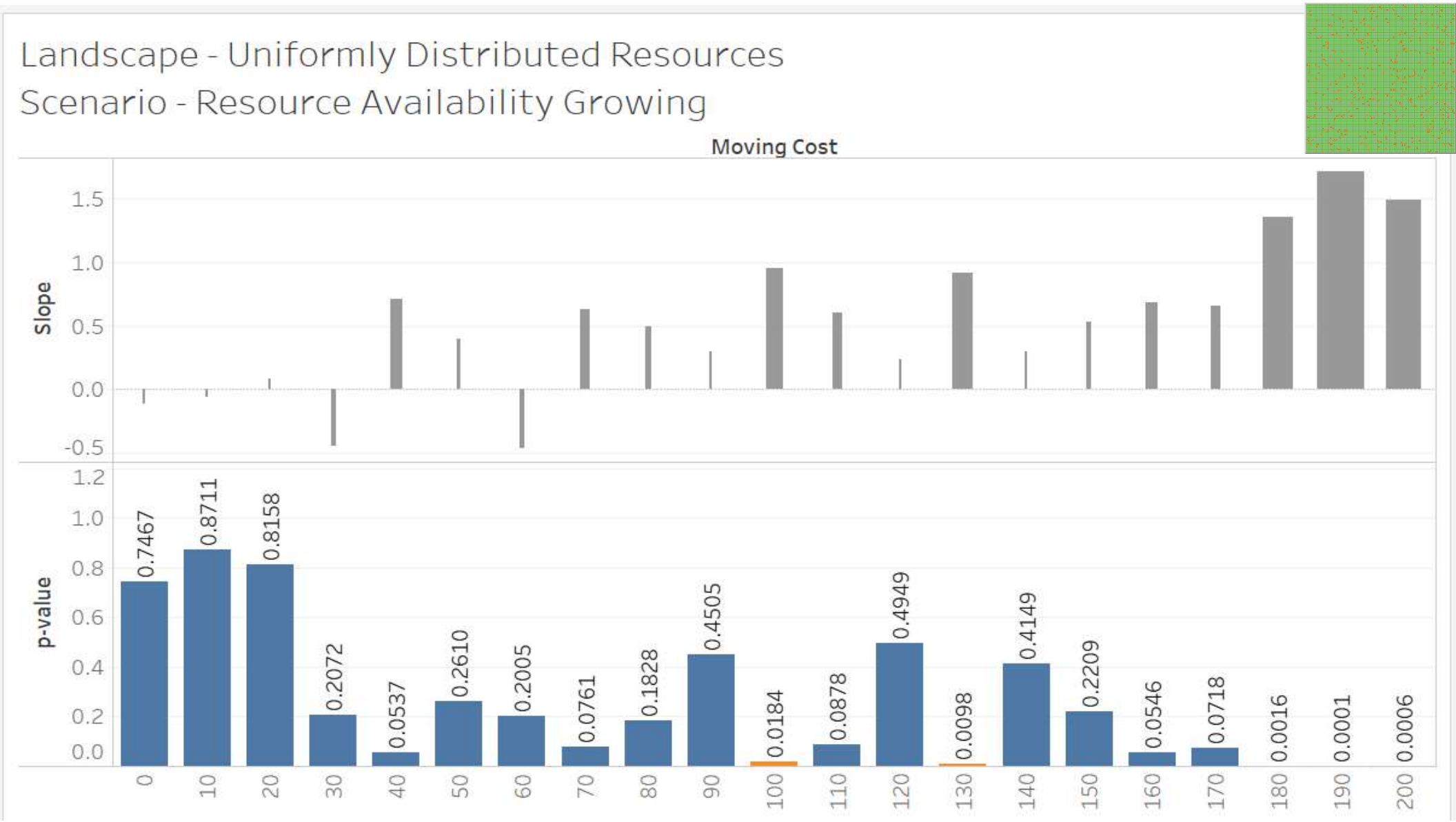

Landscape - Uniformly Distributed Resources
Scenario - Resource Availability Constant
Moving Cost
Slope
3
2
1
0
p-value
0.5
0.4
0.3
0.2
0.1
0.0
0.2143
0.0388
0.0055
0.0006
0.0013
0.0307
0.0175
0.0859
0.3962
0.0000
0.0021
0.0000
0.0000
0.0000
0.0000
0.0000
0.0013
0.0011
0.0000
0.0107
0.0000
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200

Relationship between Persistence and Wealth Acquired

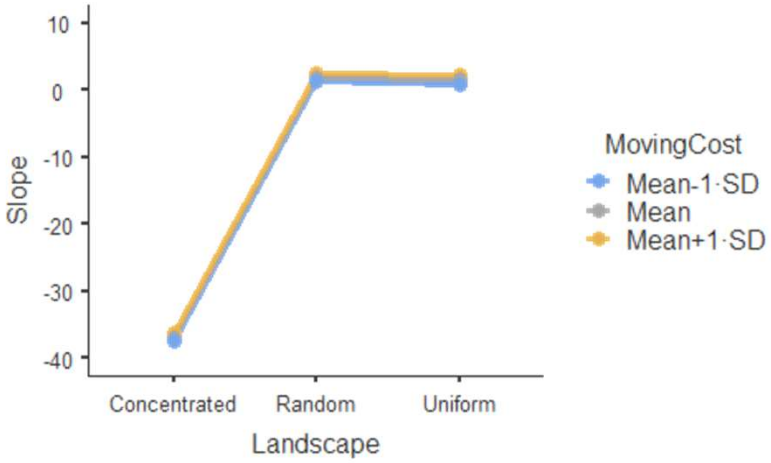
- Resources uniformly distributed in a region – Resources growing over time



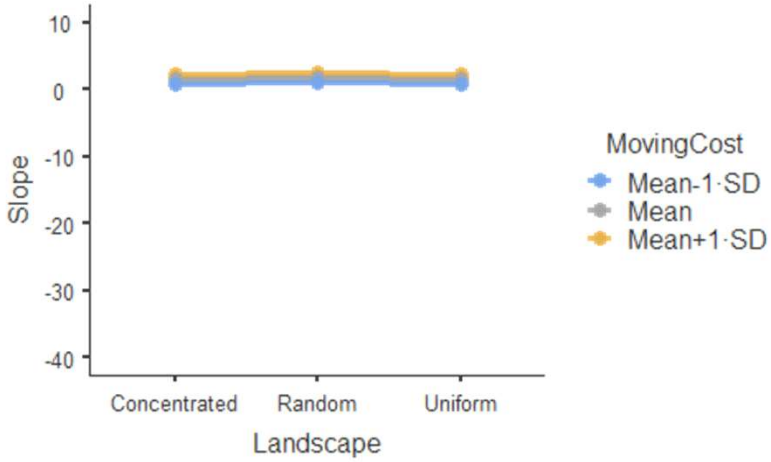

Adj R2 = -0.0017979 Intercept = 71878 Slope = -0.11134 P = 0.74667
Adj R2 = -0.0018988 Intercept = 71242 Slope = 0.082315 P = 0.81583
Intercept = 71686 Slope = -0.057431 P = 0.8711
Adj R2 = 0.0011913 Intercept = 71764 Slope = -0.44652 P = 0.20718
Adj R2 = 0.00546 Intercept = 71142 Slope = 0.71097 P = 0.053707
Adj R2 = 0.00053377 Intercept = 71582 Slope = 0.39896 P = 0.26097
Adj R2 = 0.0012877 Intercept = 72051 Slope = -0.46183 P = 0.20046
Adj R2 = 0.0043187 Intercept = 71191 Slope = 0.62955 P = 0.076072
Adj R2 = 0.0015629 Intercept = 71632 Slope = 0.49875 P = 0.18281
Adj R2 = -0.00086347 Intercept = 71375 Slope = 0.29568 P = 0.45047
Adj R2 = 0.009115 Intercept = 71203 Slope = 0.95051 P = 0.018444
Adj R2 = 0.003844 Intercept = 71002 Slope = 0.60225 P = 0.087809
Adj R2 = -0.0010702 Intercept = 71651 Slope = 0.23558 P = 0.4949
Adj R2 = 0.011351 Intercept = 71308 Slope = 0.9139 P = 0.0097642
Adj R2 = -0.00066983 Intercept = 71500 Slope = 0.30131 P = 0.41485
Adj R2 = 0.0010077 Intercept = 71101 Slope = 0.52947 P = 0.22089
Adj R2 = 0.0054297 Intercept = 71214 Slope = 0.68534 P = 0.054551
Adj R2 = 0.004498 Intercept = 70929 Slope = 0.66006 P = 0.071826
Adj R2 = 0.017867 Intercept = 70865 Slope = 1.3615 P = 0.0015935
Adj R2 = 0.029345 Intercept = 70519 Slope = 1.7147 P = 7.205e-05
Adj R2 = 0.021524 Intercept = 70404 Slope = 1.4906 P = 0.00058497
Wealth Acquired
Persistence


Landscape - Uniformly Distributed Resources
Scenario - Resource Availability Growing
Moving Cost
Slope
1.5
1.0
0.5
0.0
-0.5
p-value
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0.7467
0.8711
0.8158
0.2072
0.0537
0.2610
0.2005
0.0761
0.1828
0.4505
0.0184
0.0878
0.4949
0.0098
0.4149
0.2209
0.0546
0.0718
0.0016
0.0001
0.0006
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200

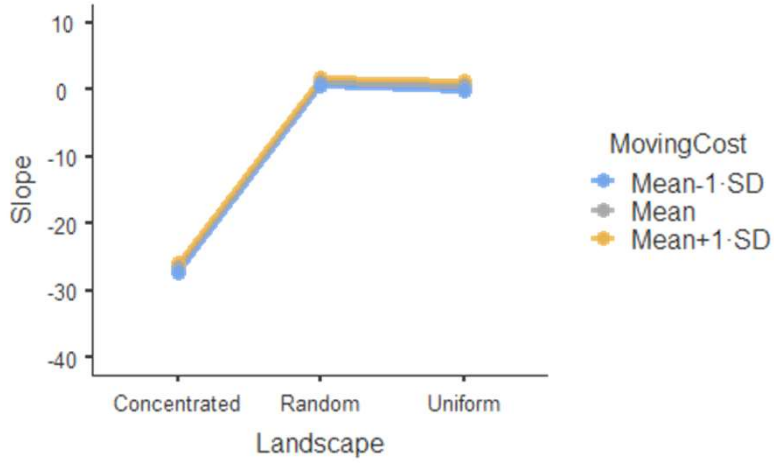
Growth Scenario = Constant Resources



Growth Scenario = Declining Resources

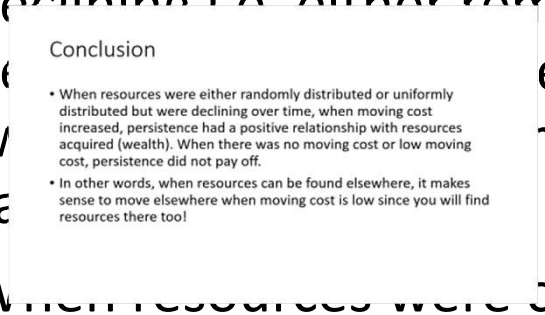


Growth Scenario = Growing Resources



Conclusion

- When resources are concentrated and when the resources were not declining i.e. either remain fixed or growing over time, there was a ne etween persistence and resources acquired (v nade sense to quit local exploration sooner and ca
- W concentrated but declining over time, when moving cost increased, persistence had a positive relationship with resources acquired (wealth). When there was no moving cost, persistence did not pay off.



Conclusion

- When resources were either randomly distributed or uniformly distributed but were declining over time, when moving cost increased, persistence had a positive relationship with resources acquired (wealth). When there was no moving cost or low moving cost, persistence did not pay off.
- In other words, when resources can be found elsewhere, it makes sense to move elsewhere when moving cost is low since you will find resources there too!

Future Work

- Different types of resources – some more valuable than others. Exploration would involve switching entirely between pursuit of resources to identify which ones seem to have a better pay-off

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