

# Analysis of Area Revisitation Patterns in World of Warcraft

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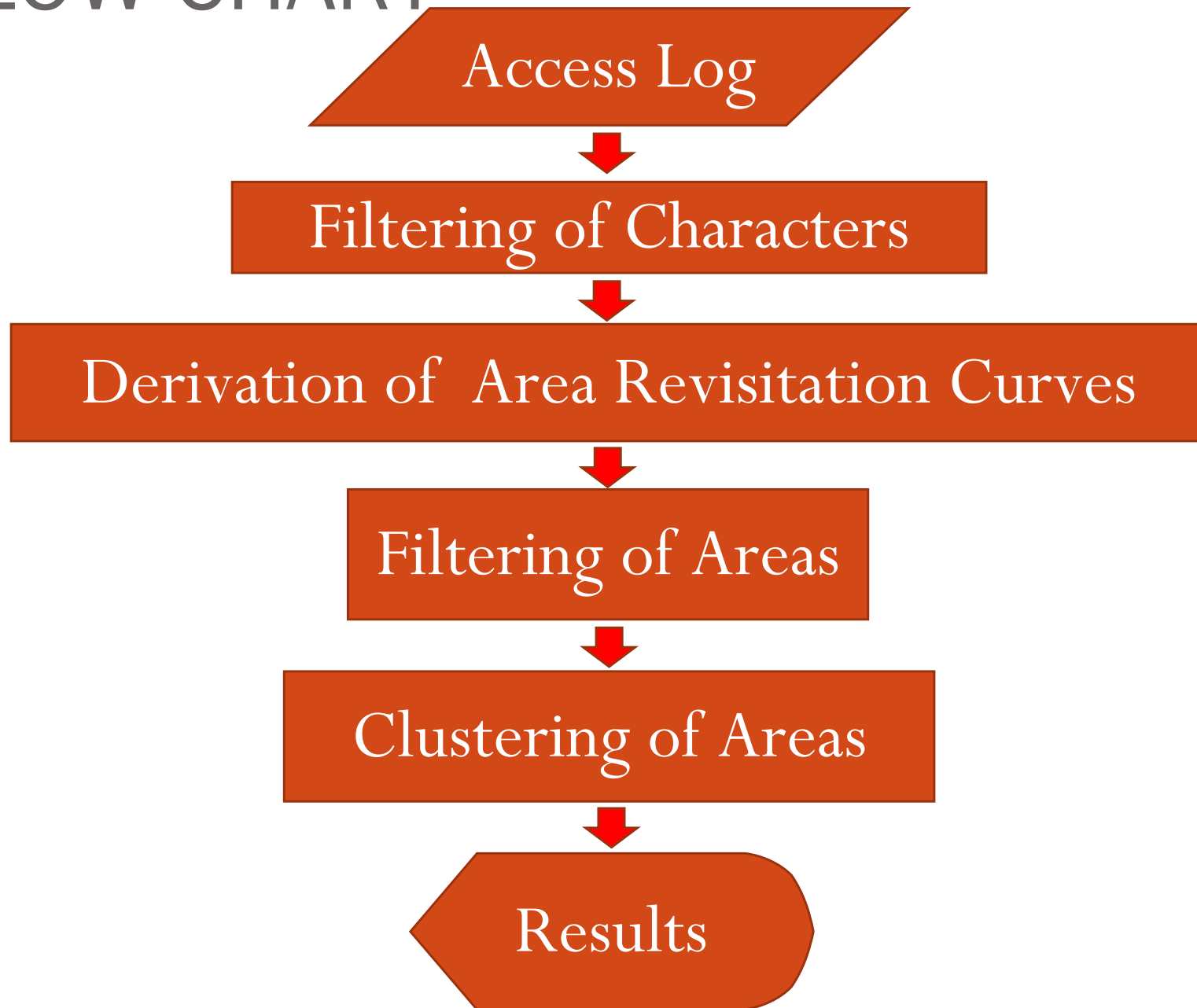
*Academia Sinica, Taiwan*

# Background & Objective

- MMOG players visit an area with a purpose
- To analyze area revisitation patterns
  - players
  - developers
- Inspired by and based on
  - Eytan Adar, Jaime Teevan, and Susan Dumais, *Large Scale Analysis of Web Revisitation Patterns*, CHI08



# FLOW CHART



# Access Log of WoW

- World of Warcraft
  - Horde vs Alliance
- /who every 10 mins at a server in Taiwan  
Jan 2006 – Dec 2007
- More than 600,000 characters



# Filtering of Characters

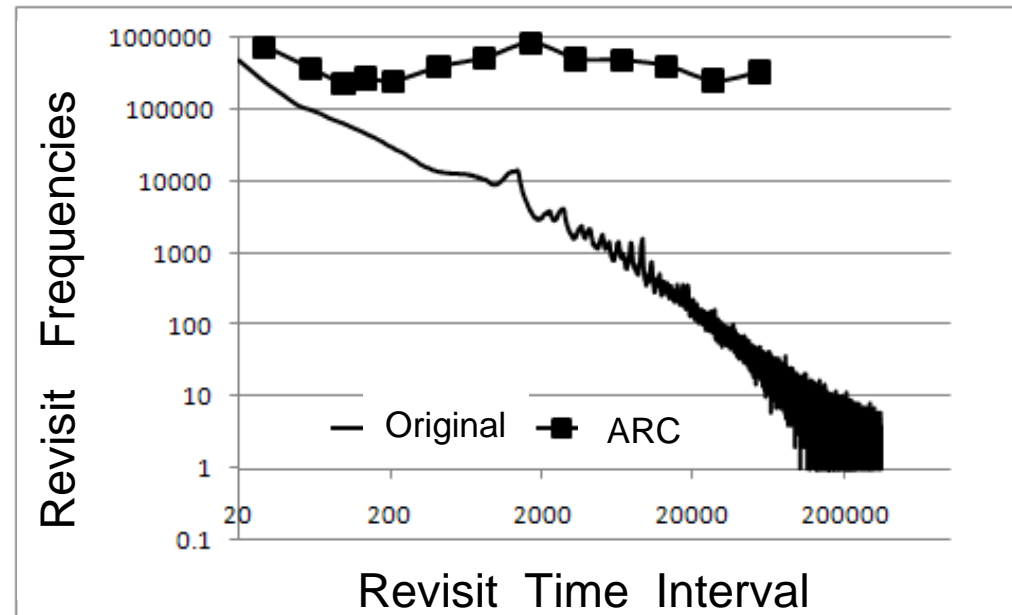
- Remove characters
  - Total access time below 40 hours
  - Total access time with the 99th percentile
  - One of the parameters below 10<sup>th</sup> percentile
    - Area Transitions 6
    - Unique Areas Visited 4
    - Areas Revisited 3
    - Area-Transition Ratio 6/10

Area B's Revisit Time

Time	Area
10/08/06 02:12:37	A
10/08/06 02:22:28	A
10/08/06 02:32:37	B
10/08/06 02:42:38	C
10/08/06 03:02:30	D
10/08/06 03:12:37	D
10/08/06 03:22:35	B
10/09/06 00:52:37	C
10/09/06 01:02:37	A
10/12/06 23:36:37	A

1  
2  
3  
4  
5  
6

# Area Revisitation Curves



- Histogram of revisit time intervals of an area of interest
- X-axis: Revisit time intervals
  - Log-like time scale partitioned to 13 bins
- Y-Axis: Revisit frequencies
  - Normalization

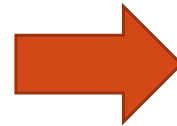
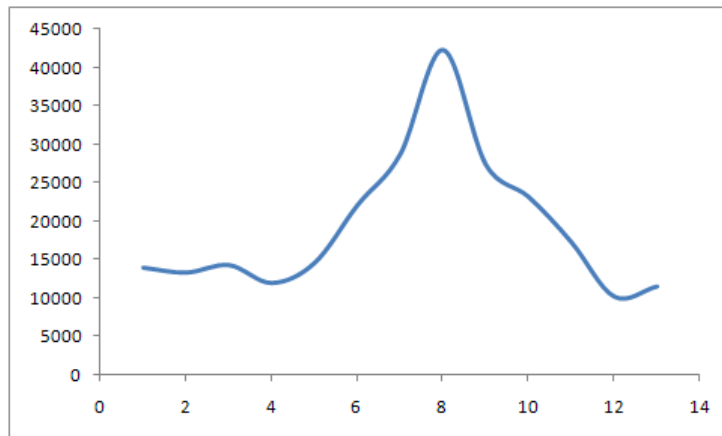
# Log-like Time Scale

<b>BIN</b>	<b>Intervals</b>	<b>Intervals (min)</b>	<b>Adjusting Parameters</b>	<b>Lengths</b>
1	30 mins	30	2	32
2	1 hour	60	4	64
3	1.5 hours	90	8	98
4	2 hours	120	16	136
5	3 hours	180	32	212
6	6 hours	360	64	424
7	12 hours	720	128	848
8	1 day	1440	256	1696
9	2 days	2880	512	3392
1 0	4 days	5760	1024	6784
1 1	8 days	11520	2048	13568
1 2	16 days	23040	4096	27136
1 3	Above 16 days			Above 27136

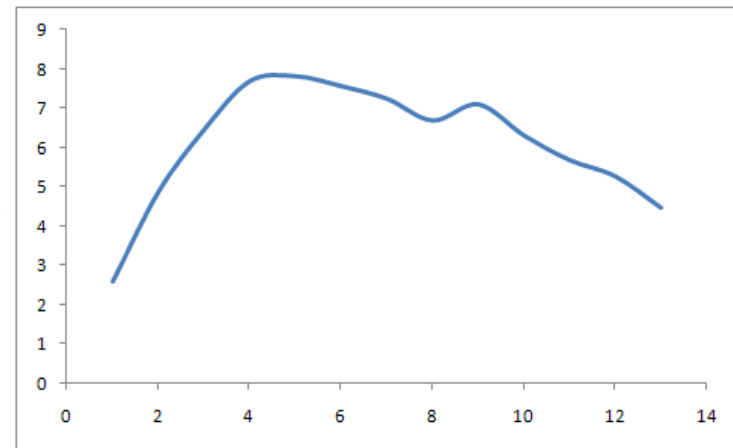
# Normalization

- For each area,
  - divide each bin value by the average among all areas at the same bin

BEFORE



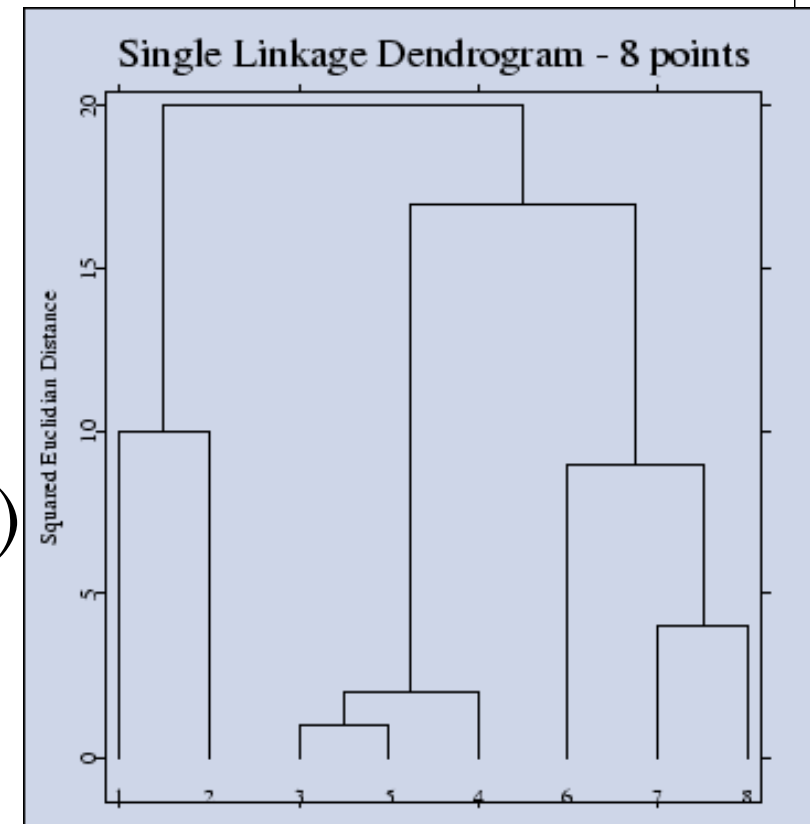
AFTER



# Area Clustering

- Input vector of Area  $i$ :
  - 13 elements, 13 bins of the normalized revisitation curve of Area  $i$
- Distance Measure
  - Cosine distance ( $A \cdot B / (|A| |B|)$ )
- Ward Clustering (Agglomerative)
- Number of Clusters

$$\frac{\text{interclass variance}/(\text{number of clusters} - 1)}{\text{intraclass variance}/(\text{number of areas} - \text{number of clusters})}$$

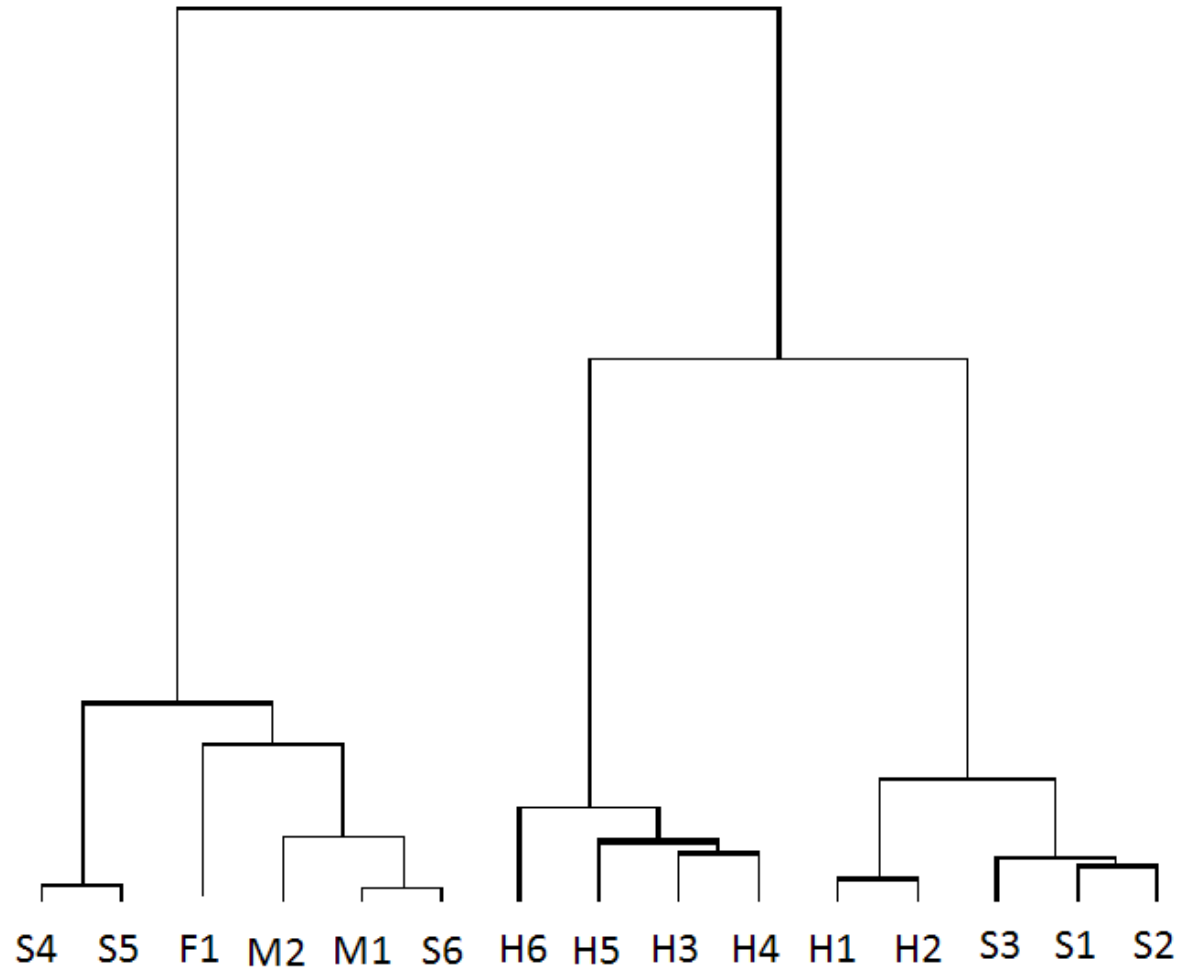


# Filtering of Areas

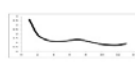
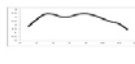
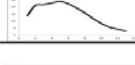
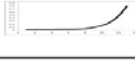
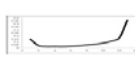
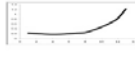
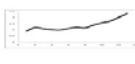
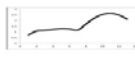
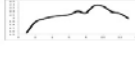
- Remove areas
  - Sum of bin values is 1<sup>st</sup> percentile

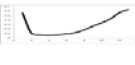
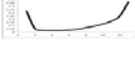
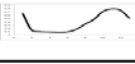
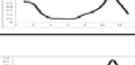
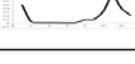

# Clustering Results (1/2)

- 15 clusters
- 4 types based on peak locations
  - Fast
  - Medium
  - Slow
  - Hybrid



# Clustering Results (2/2)

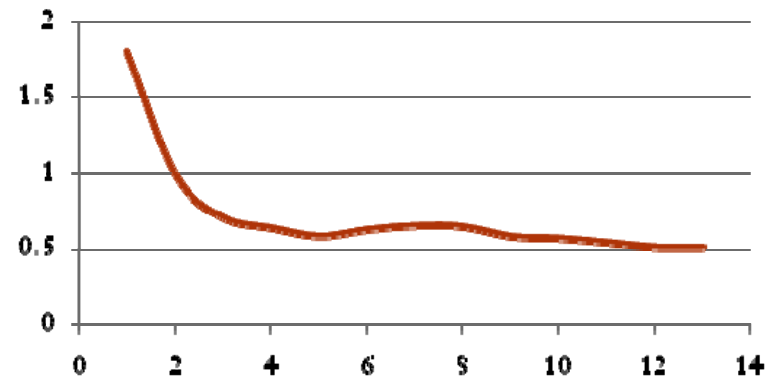
Group	Cluster	Centroid Curve	Number of Areas	Area Names
Fast	F1		7	Alterac Valley, Arathi Basin, Eversong Woods, Eye of the Storm, Ghostlands, Maraudon, Warsong Gulch
Medium	M1		8	Blade's Edge Mountains, Hellfire Peninsula, Nagrand, Netherstorm, Shadowmoon Valley, Terokkar Forest, Undercity, Zangarmarsh
	M2		2	Orgrimmar, Shattrath City
Slow	S1		6	Duskwood, Elwynn Forest, Loch Modan, Redridge Mountains, Twisting Nether, Wetlands
	S2		5	Blackfathom Deeps, Ragefire Chasm, Razorfen Downs, Razorfen Kraul, Shadowfang Keep
	S3		11	Blasted Lands, Burning Steppes, Darkshore, Dustwallow Marsh, Hall of Legends, Moonglade, Mulgore, Scarlet Monastery, Swamp of Sorrows, The Temple of Atal'Hakkar, Wailing Caverns
	S4		14	Alterac Mountains, Arathi Highlands, Ashenvale, Azshara, Badlands, Desolace, Feralas, Hillsbrad Foothills, Silverpine Forest, Tanaris, The Hinterlands, Thousand Needles, Thunder Bluff, Un'Goro Crater
	S5		6	Blackrock Mountain, Deadwind Pass, Durotar, Gates of Ahn'Qiraj, Scaring Gorge, Tirisfal Glades
	S6		9	Eastern Plaguelands, Felwood, Silithus, Silvermoon City, Stonetalon Mountains, Stranglethorn Vale, The Barrens, Western Plaguelands, Winterspring

Group	Cluster	Centroid Curve	Number of Areas	Area Names
Hybrid	H1		11	Dire Maul, Hellfire Ramparts, Scholomance, Shadow Labyrinth, Stratholme, The Arcatraz, The Black Morass, The Botanica, The Shattered Halls, The Steamvault, The Underbog
	H2		10	Auchenai Crypts, Blackrock Depths, Gnomeregan, Mana-Tombs, Old Hillsbrad Foothills, Ssethekk Halls, The Blood Furnace, The Slave Pens, Uldaman, Zul'Farrak
	H3		5	Blackrock Spire, Naxxramas, Ruins of Ahn'Qiraj, The Mechanar, Zul'Gurub
	H4		3	Blade's Edge Arena, Nagrand Arena, Ruins of Lordaeron
	H5		5	Gruul's Lair, Magtheridon's Lair, Molten Core, Onyxia's Lair, Tempest Keep
	H6		5	Ahn'Qiraj, Blackwing Lair, Karazhan, Serpentshrine Cavern, Zul'Aman

# Fast

- Revisited within 1 hour

## Eye of the Storm



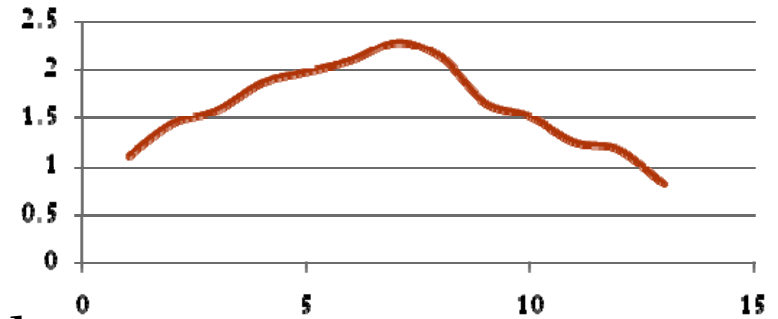
- All four PvP battle grounds and Blood Elves starting areas



# Medium

- Revisited regularly
  - Peaks between 1 hour and 1 day
- Daily quest areas (M1)
  - Wait for a reset after having completed the maximum of number of daily quests
- Capital cities (M1, M2)
  - Use the banking and auction functions

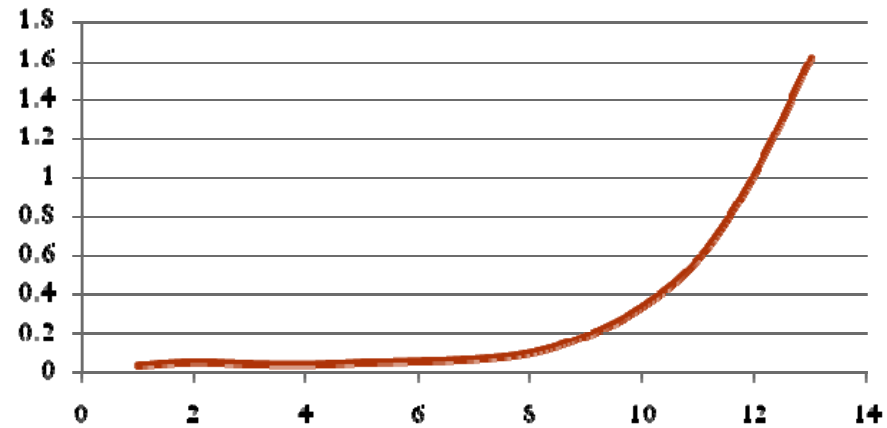
## Shadowmoon Valley



# Slow

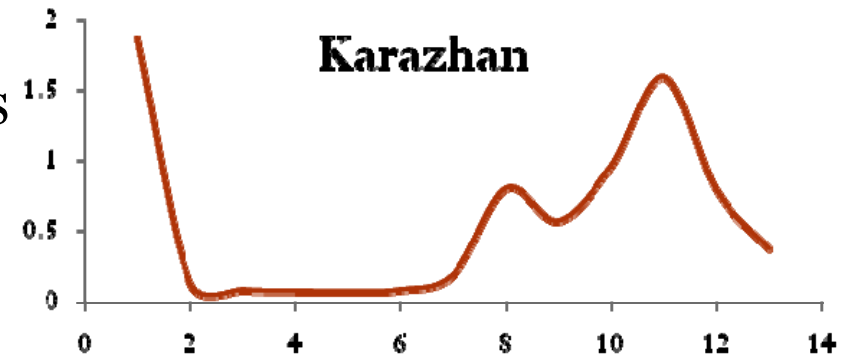
- Peaks beyond one day
- Low-level instances
  - Dungeons less popular among mid-level and veteran characters
- Monthly event
  - Elwynn Forest & Mulgore holding the Darkmoon faire

Duskwood



# Hybrid

- Have both fast and slow peaks
- High level Instances
  - Wipe out and lock out
- Arenas
  - Battle team v team and then wait for a reward



# Design Implications

- Area Design Reconsideration
  - Investigate unexpectedly popular or unpopular areas
- Players' Social Network Solidification
  - Build a social network for players with similar area revisitation patterns
- Player Support
  - Provide a personalized service to each player based on revisitation patterns

# Conclusions and Future Work

- Revisitation patterns in WoW
  - Applicable to other MMOGs
- 4 groups of areas
  - Fast, Medium, Slow and Hybrid
- Design implications
  - Area redesign, social network, and personalized services
- Future Work
  - Prediction of the timing to quit the game