

## **Kynning**

mánudaginn 10. september 2018

í Háskólanum í Reykjavík

stofu M104

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# **Kosningakerfahermir**

# Ágrip

- Hugbúnaður til prófunar á tvívíðu kosningakerfi eins og því íslenska
- Velja má
  - uppskiptingu í kjördæmi
  - skiptingu og tölu kjördæmis- og jöfnunarsæta
  - grunnúthlutunaraðferð
  - þröskuldur eða ekki o.s.frv.
- Leggja má raunverulega eða dæmigerða skipan flokka og fylgis þeirra til grundvallar
- Búin eru til mörg slembikennd kosningaúrslit (t.d. 10.000) sem snúast kringum hin inngefnu úrslit
- Fundin er meðaltalsúthlutun, staðalfrávik svo og alls kyns gæðamælikvarðar reiknaðir
  - (ENN sem komið er ekki fengist við persónukjör)

# Aðstandendur, markmið og fyrirvarar

- „Kosningafræðaklúbburinn“; sjá fésbók; einkum þessir:
  - Martha Guðrún Bjarnadóttir, nemi við HR í tölvunarstærðfræði, með styrk úr Nýsköpunarsjóði námsmanna, nr. 185597-0091
  - Pétur Ólafur Aðalgeirsson, forritun og stærðfræði
  - Smári McCarthy, hugbúnaðarhönnun
  - Þorkell Helgason, fræðilegur bakgrunnur
- Markmið
  - Verkfæri til að prófa mismunandi fyrirkomulag við skipan kjördæma og úthlutunaraðferða
  - Upphaflega fræðilegs eðlis, þ.e.a.s. að þróa og prófa nálgunaraðferðir á svokallaðri bestu úthlutunaraðferð
- Ekki verið að leggja til tilteknar breytingar
  - En hugbúnaðurinn er tól til þess

# Fræðin að baki

Þorkell Helgason

# Tvívíð úthlutun í hnotskurn

- Landinu er skipt upp í *kjördæmi*
- Hluti þingsæta hvers kjördæmis eru *kjördæmissæti*
  - Þeim er úthlutað hlutfallslega á grundvelli úrslita innan hvers þeirra
    - með reglu d'Hondts, Sainte-Laguë eða með öðrum hætti
- Önnur sæti eru til jöfnunar á milli flokka, *jöfnunarsæti*
  - Skipt á milli kjördæma áður en kosið er
  - Skipt upp á milli flokka eftir landsfylgi (í kjölfar kjördæmissæta)
    - með reglu d'Hondts, Sainte-Laguë eða með öðrum hætti
    - að gefnum lágmarksþröskuldi ef við á
- Að lokum er jöfnunarsætum útdeilt til einstakra lista
  - innan flokka og kjördæma

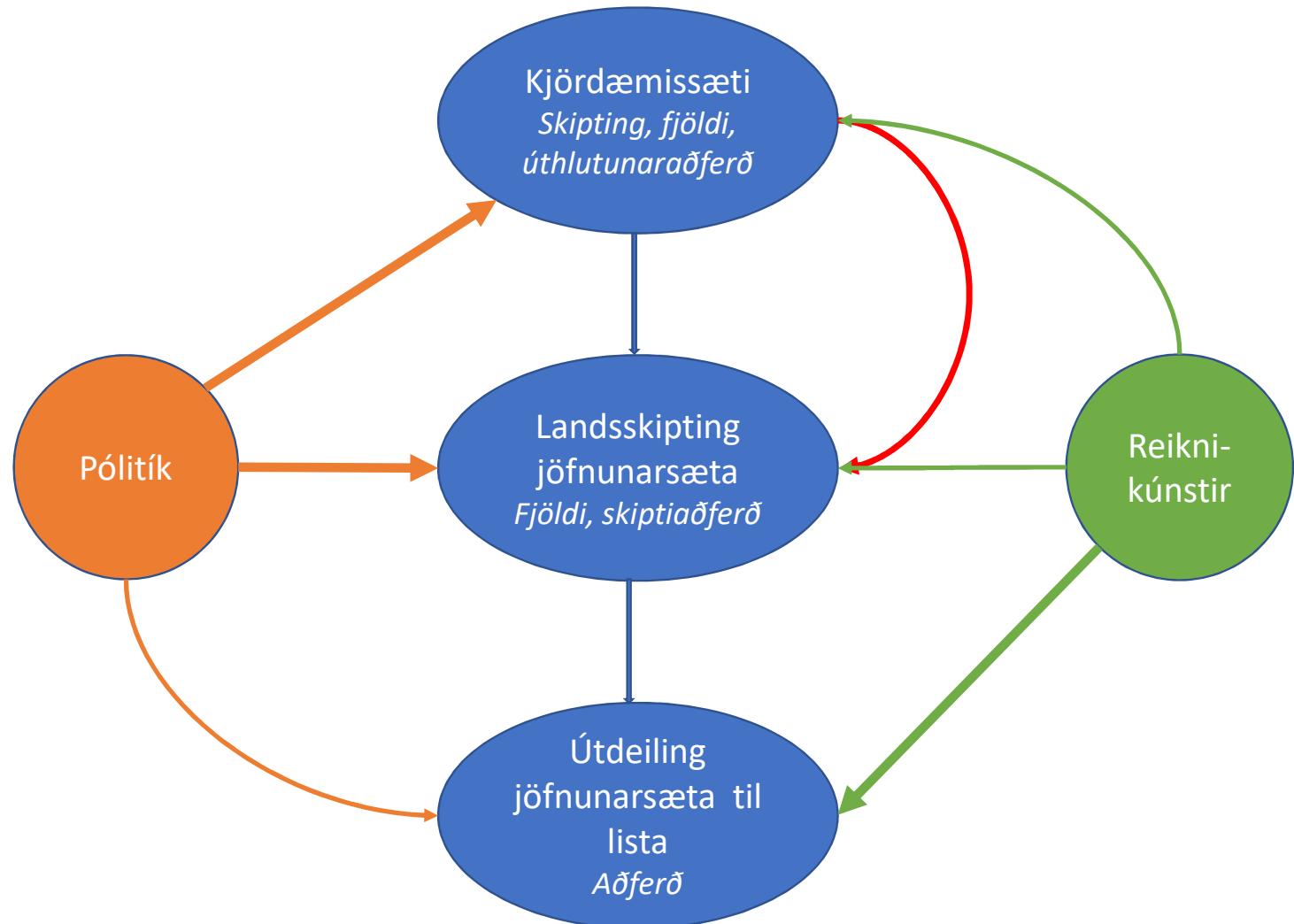
# Viðfangsefni tvívíðrar úthlutunar

*er að fylla út í töfluna  
þannig að summur lóðrétt og lárétt séu réttar  
um leið og úthlutunin sé í sem bestu "hlutfalli" við atkvæði greidd einstökum listum.  
(Kosningar 2003 sem dæmi)*

Listabókstafur:	B	D	F	S	U	Sæti alls	þar af kjörd.s.	þar af jöfnunars.
Norðvesturkjördæmi						10	9	1
Norðausturkjördæmi						10	9	1
Suðurkjördæmi			?			10	9	1
Suðvesturkjördæmi						11	9	2
Reykjavíkurkjördæmi suður						11	9	2
Reykjavíkurkjördæmi norður						11	9	2
<b>Heildartala þingsæta</b>	<b>12</b>	<b>22</b>	<b>4</b>	<b>20</b>	<b>5</b>	<b>63</b>	<b>54</b>	<b>9</b>
<i>þar afkjördæmissæti</i>	11	19	2	18	4	54		
<i>þar afjöfnunarsæti</i>	1	3	2	2	1	9		

Á við Ísland, Noreg og mörg fleiri ríki eða svæði

# Tvívíð úthlutun: þættir og áhuga- valdar



# Kröfur (að hætti Balinski og Demange) til “gæðalausnar”

(alltaf að gefinni heildarskiptingu sæta milli kjördæma og á milli flokka)

- **Kjörfylgi og þingfylgi haldist í hendur**
  - Listi skal aldrei tapa sætum, auki hann fylgi sitt
  - Og öfugt, minnki fylgið
- **Innra samræmi aðferðarinnar**
  - Breytingar á atkvæðum einstakra lista, sem valda þó ekki neinni breytingu á úthlutun til þeirra, mega ekki hrófla við úthlutun til annarra lista
- **Óháð skölun**
  - Einvíð skölun á atkvæðum innan einstakra kjördæma skal engu breyta
  - Ekki heldur ef atkvæði flokka eru sköluð (umdeilanleg krafa)
- **Grunnkröfur**
  - Nokkrar einfaldar, rökfræðilegar kröfur

# Hvernig verður þá best úthlutað?

## Sannað hefur verið að

- aðeins er til „ein“ lausn, „ein“ aðferð sem leysir vandann og virðir allar gæðakröfur

## Hver er hún?

- Sætunum (jöfnunarsætum) skal útdeilt þannig að heildarmargfeldi atkvæða að baki þingsætum sé í hámarki
- Stærðfræðilega einfalt og skýrt markmið
- Stuttur lagatexti

# Tvívíð gæðaúthlutun sem línuleg bestun

Lágmörkun  
óreiðu:

Entropy LP-problem

$$\max \left[ \sum_i \sum_j \sum_k \ln \left( \frac{V_{ij}}{d_k} \right) x_{ijk} \right]$$

subject to the constraints

$$\sum_j \sum_k x_{ijk} = C_i \quad \forall i$$

$$\sum_i \sum_k x_{ijk} = P_j \quad \forall j$$

$$\sum_i \sum_j \sum_k x_{ijk} = A$$

$$\sum_k x_{ijk} \geq m_{ij} \quad \forall i, j$$

$$0 \leq x_{ijk} \leq 1 \quad \forall i, j, k$$

# Raunúthlutun 2003 – færð til bestu lausnar

Eina leiðréttin sem gera þarf er í  
í Suðurkjördæmi og Reykjavíkurkjördæmi norður

*Breyting á heildarúthlutun þingsæta með „bestu“ úthlutun.*

Listabókstafur:	B	D	F	N	S	T	U	Alls
Norðvesturkjördæmi	2	3	2	-	2	-	1	10
Norðausturkjördæmi	4	2	-	-	2	-	2	10
Suðurkjördæmi	2+1	3	1	-	4-1	-	-	10
Suðvesturkjördæmi	1	5	1	-	4	-	-	11
Reykjavíkurkjördæmi suður	1	5	-	-	4	-	1	11
Reykjavíkurkjördæmi norður	2-1	4	-	-	4+1	-	1	11
Heildartala þingsæta	12	22	4	-	20	-	5	63

# Hvernig leyfist að úthluta sætum?

## Gæðaúthlutunin fæst aðeins með ítrun

- Hið stærðfræðilega flækjustig er þannig vaxið að besta lausnin verður aldrei fundin án ítrana, þ.e.a.s. runu tilraunaúthlutana þar til endanlega lausnin er fundin

## Seilingaraðferðir

- Hér er átt við að sætum sé úthlutað í bunu, einu sæti í senn á grundvelli einhvers mælikvarða. Aldrei er horft um öxl og fyrri úthlutun dregin til baka

## Pólitískt leyfilegt

- Hvorki stjórnmálamenn né lögfræðingar eru ginnkeyptir fyrir ítrunum.
- Því koma aðeins seilingaraðferðir til álita

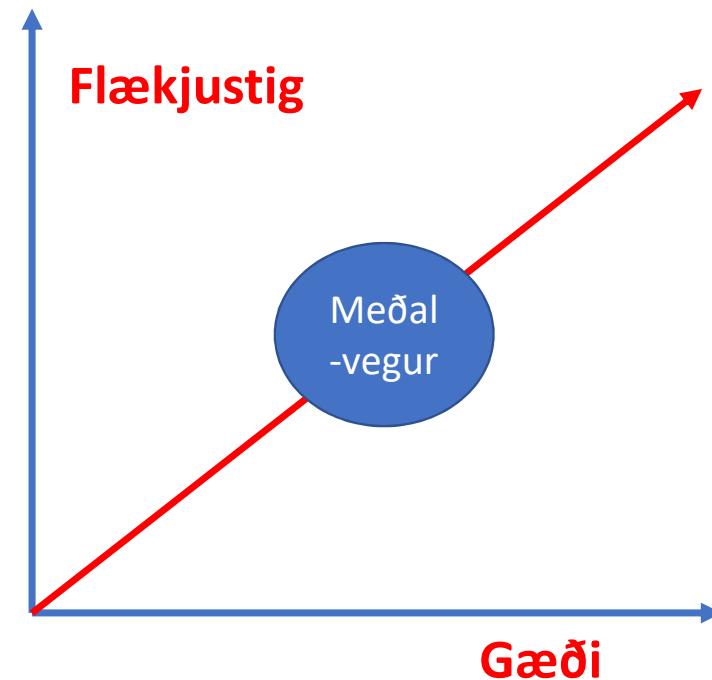
# Nálgunarleiðir að bestu lausn

## Pólítískar kröfur

- Sætum verður að úthluta í halarófu, aldrei má líta um öxl
- Ekki of flóknar

## Gæðakrafa

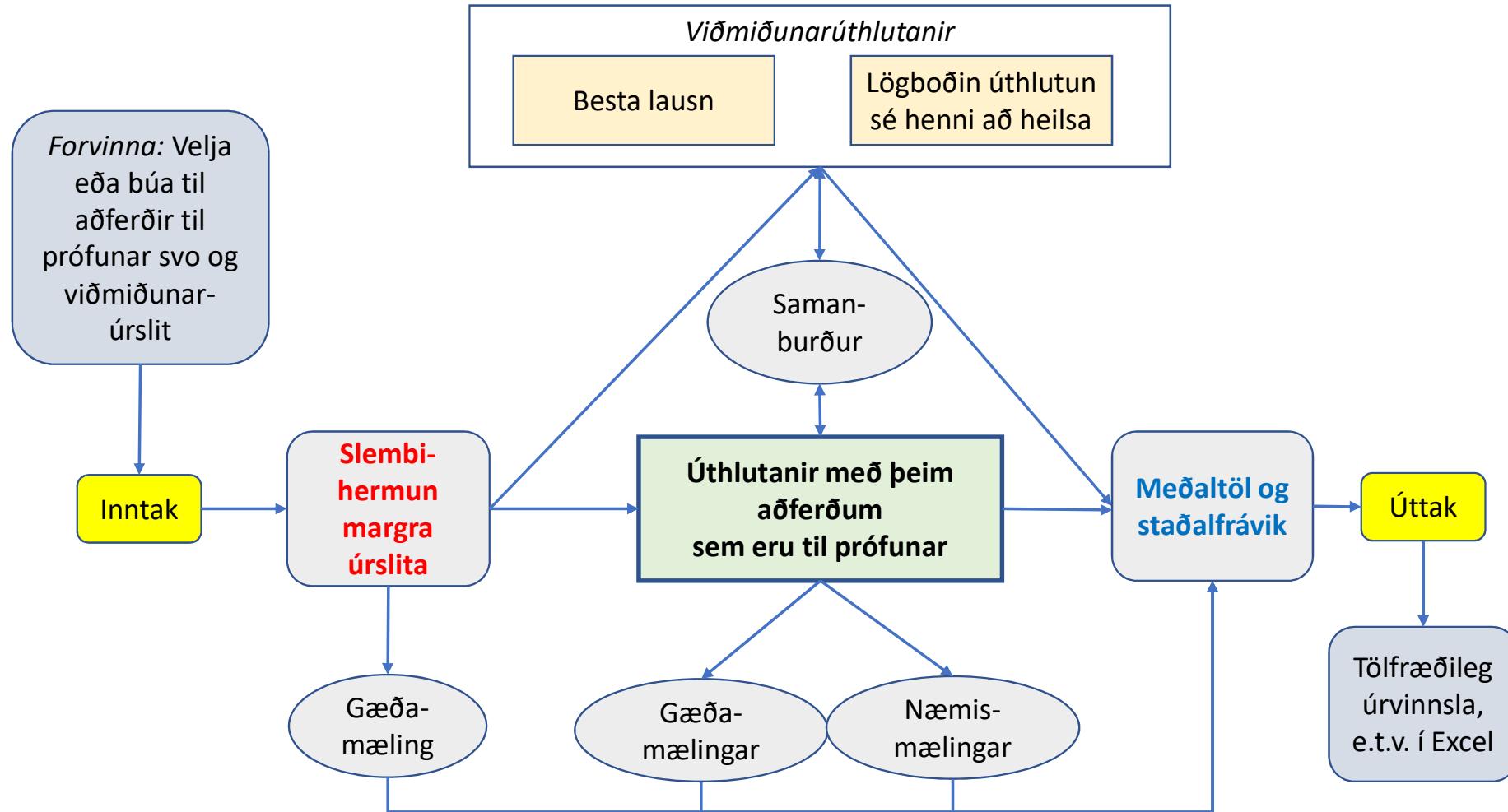
- Líkja sem næst eftir bestu lausn, „gæðalausninni“



## Aðferðir sem hafa verið forritaðar

- Gæðaaðferðin
- Íslensk og norsk lög, svo og „íslenskuð“ útgáfa þeirra norsku
- Forskotsaðferð (þH)
- Víxlunaraðferð (KL og þH)
- Aðferð kennd við Monge (þH, PÓA)
- O.fl. í bígerð

# Einföld mynd af kosningakerfisherminum



# Gæðamælikvarðar

- Viðmið við bestu lausn
  - Frávik margfeldis atkvæða að baki sæta
  - Frávik tölu sæta
- Kjördæmafrávik
  - Hve oft verður að víkja frá hreinni kjördæmisúthlutun
- Hlutfallsleg úthlutun
  - Loosmore og Hanby kvarðinn (útfærður fyrir tvívídd)
- Mælikvarðar á grundvelli grunnaðferða
  - Laguë
  - d'Hondt (tveir slíkir)

*LHMethod*

$$:= \frac{1}{SeatsTotal} \sum_{i \in Constituencies} \sum_{j \in Parties} |BiSeatShares_{ij} - SeatsListMethod_{ij}|$$

*LagueTestMethod*

$$:= Scale \sum_{i \in Constituencies} \sum_{j \in Parties} \frac{(BiSeatShares_{ij} - SeatsListMethod_{ij})^2}{BiSeatShares_{ij}}$$

$$dHondtMinMethod := \min_{i \in Constituencies} \min_{j \in Parties} \frac{BiSeatShares_{ij}}{SeatsListMethod_{ij}}$$

$$dHondtSumMethod := 2 Scale \sum_{i \in Constituencies} \sum_{j \in Parties} \frac{(BiSeatShares_{ij} - SeatsListMethod_{ij})^+}{BiSeatShares_{ij}}$$

# Sýning á hugbúnaðinum

Martha Guðrún Bjarnadóttir

A screenshot of a web browser window displaying the "Voting system simulator" homepage. The browser's address bar shows the URL "voting.smarimccarthy.is/#/" and indicates it is "Not secure". The title bar has the word "Voting". The top navigation bar includes links for "Voting", "Instructions", "Single Election", and "Simulate". The main content area features a large heading "Voting system simulator" and a subtext: "Hello! This is a voting system simulator. Above, you can choose between two modes: **Single Election** and **Simulate**". Below this, a section titled "About" provides information about the software's purpose and creators. It states: "The aim of this software is to help people understand how certain types of voting systems work under various conditions. It provides tools to calculate election results for certain systems and review various metrics for these systems under simulation." Another section discusses the software's availability and funding: "This software is free to use for experimental purposes, and is free/open source software, available from [Github](#). If you are using it for commercial or political reasons, please contact us to discuss supporting our project financially." A final section credits the creators: "The voting system simulator is made by:" followed by a bulleted list of names.

# Voting system simulator

Hello! This is a voting system simulator. Above, you can choose between two modes: **Single Election** and **Simulate**.

## About

The aim of this software is to help people understand how certain types of voting systems work under various conditions. It provides tools to calculate election results for certain systems and review various metrics for these systems under simulation.

This software is free to use for experimental purposes, and is free/open source software, available from [Github](#). If you are using it for commercial or political reasons, please contact us to discuss supporting our project financially.

The voting system simulator is made by:

- Smári McCarthy (smarim@althingi.is)
- Þorkell Helgason (thorkellhelga@gmail.com)
- Martha Guðrún Bjarnadóttir
- Pétur Ólafur Aðalgeirsson
- Helgi Hrafn Gunnarsson
- Bjartur Thorlacius

## Single Election

**Single Election** allows you to calculate the results of a single election. You need to provide **election rules** along with information about the **constituencies** in the country, the **parties** running in the election, and the **votes** each party got in each constituency.



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Martha Guðrún

## Single Election

**Single Election** allows you to calculate the results of a single election. You need to provide **election rules** along with information about the **constituencies** in the country, the **parties** running in the election, and the **votes** each party got in each constituency.

As you update these values, the result will be automatically calculated and the results displayed below.

When choosing the *election rules*, you have a lot of different options to choose from — for a deeper understanding of these, you should read our guides on **divider rules** and **adjustment methods**.

Run a single election

## Simulate

The **Simulate** function allows you to run hundreds or even thousands of elections, each differing slightly from the last, in order to gain insights into the behaviour of different *voting systems*.

By setting up several different systems, you can *compare* the statistical behaviour to see which systems do best under certain test conditions. The results are displayed in the form of several different **quality measures**, each with their own interpretation.

As with running a single election, you must provide information about the **constituencies** in the country, the **parties** running in the election, and the **votes** each party got in each constituency.

In addition to this, you must provide at least one set of **election rules** to be considered, but you can have as many rules as you'd like.

When choosing the *election rules*, you have a lot of different options to choose from — for a deeper understanding of these, you should read our guides on **divider rules** and **adjustment methods**.

Run a simulation

Voting x Martha Guðrún – □ ×

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Voting Instructions Single Election Simulate

# Election

## Votes

Add constituency Add party Clear votes Reset everything Upload votes Paste input Load preset Save voteset

	# Cons.	# Adj.	x	A	x	B
x I	10	2	1500	2000		
x II	10	3	2500	1700		

## Settings

Divider for allocating constituency seats Adjustment method

D'Hondt's method Icelandic law 24/2000 (Kosningar til Alþingis)

Voting   Martha Guðrún

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Voting Instructions Single Election Simulate

# Election

## Votes

Add constituency Add party Clear votes Reset everything Upload votes Paste input Load preset Save voteset

	# Cons.	# Adj.	x	A	x	B	x	C
x I	10	2	1500	2000	1459			
x II	10	3	2500	1700	1347			
x III	11	3	1877	3001	2345			

## Settings

Divider for allocating constituency seats

D'Hondt's method

Adjustment method

Icelandic law 24/2000 (Kosningar til Alþingis)

Voting x Martha Guðrún – □ ×

Not secure | voting.smarimccarthy.is/#/election ☆ ⋮

Voting Instructions Single Election Simulate

# Election

## Votes

Add constituency Add party Clear votes Reset everything Upload votes Paste input Load preset Save voteset

	# Cons.	# Adj.	x	A	x	C
x II	10	3	2500	1347		
x III	11	3	1877	2345		

## Settings

Divider for allocating constituency seats Adjustment method

D'Hondt's method Icelandic law 24/2000 (Kosningar til Alþingis)

Voting

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Martha Guðrún

Election

Votes

Add constituency Add party

x I

x II

Settings

Divider for allocating constituency seats

D'Hondt's method

Adjustment method

Icelandic law 24/2000 (Kosningar til Alþingis)

Load preset

Name	Year	Country	Actions
Alþingi elections	2003	Iceland	Load
Alþingi elections	2007	Iceland	Load
Alþingi elections	2009	Iceland	Load
Alþingi elections	2013	Iceland	Load
Alþingi elections	2016	Iceland	Load

Cancel OK

Voting Martha Guðnún

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## Votes

Add constituency   Add party   Clear votes   Reset everything   Upload votes   Paste input   Load preset   Save voteset

	# Cons.	# Adj.	x	A	x	B	x	D	x	G	x	H	x	I	x
x <b>Norðvestur</b>	7	1	x	792		6104		4282		208		0		161	
x <b>Norðaustur</b>	9	1	x	1537		8173		5327		296		0		241	
x <b>Suður</b>	9	1	x	1202		9262		7594		702		0		786	
x <b>Suðvestur</b>	11	2	x	4687		10944		15608		925		0		1838	
x <b>Reykjavík suður</b>	9	2	x	3790		5931		9464		575		55		1394	
x <b>Reykjavík norður</b>	9	2	x	3576		5759		8180		556		71		1287	

## Settings

Divider for allocating constituency seats

D'Hondt's method

Adjustment method

Icelandic law 24/2000 (Kosningar til Alþingis)

Voting

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Martha Guðrún

Election Votes

Add constituency Add party

x I

x II

# Election

## Votes

Instructions Single Election Simulate

Upload CSV or XLSX file

The file provided must be a CSV or an Excel XLSX file formatted with parties on the first row and constituency names on the first column.

	A	B	C	D	E	F	G	
1		cons	adj	Lion Party	Gorilla Party	Antelope Party	Hippo Party	
2	East Jungle		5	1	221	822	72	326
3	West Jungle		6	2	103	934	48	398
4	The Oasis		5	2	340	224	238	943
5	Pride Rock		7	1	1421	79	208	245
6	Northern Savannah		4	2	321	40	782	420
7	Southern Bush		5	2	144	53	833	393
8								

Optional, if the second and third columns are named 'cons' or 'adj', they will be understood to be information about the number of constituency seats and adjustment seats, respectively, in each constituency. If you leave them out, you can specify the number of seats manually.

Choose a file...

Cancel

Divider for allocating constituency seats: D'Hondt's method

Adjustment method: Icelandic law 24/2000 (Kosningar til Alþingis)

Voting Martha Guðrún

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Voting Instructions Single Election Simulate

# Election

## Votes

Add constituency Add party Clear votes Reset everything Upload votes Paste input Load preset Save voteset

	# Cons.	# Adj.	x	A	x	B	x	C	x	D	x	E
x <b>Norður</b>	4	3	x	6817	x	4548	x	2638	x	1889	x	956
x <b>Austur</b>	4	3	x	8410	x	5739	x	3964	x	1139	x	859
x <b>Suður</b>	4	3	x	4360	x	3118	x	2067	x	1183	x	1266
x <b>Vestur</b>	4	3	x	8091	x	6718	x	2066	x	1796	x	1677

## Settings

Divider for allocating constituency seats

D'Hondt's method

Adjustment method

Icelandic law 24/2000 (Kosningar til Alþingis)

## Settings

Divider for allocating constituency seats

D'Hondt's method

Which divider rule should be used to allocate constituency seats to lists within each constituency?

Divider for apportioning adjustment seats

D'Hondt's method

Which divider rule should be used to apportion adjustment seats among parties?

Divider for allocating adjustment seats

D'Hondt's method

Which divider rule should be used to allocate adjustment seats to individual lists?

Adjustment method

Icelandic law 24/2000 (Kosningar til Alþingis)

Which method should be used to allocate adjustment seats?

Adjustment threshold

5

%

What threshold are parties required to reach to qualify for adjustment seats?

## Results

A	B

Voting	x	Martha Guðrún	-	□	×
Not secure   voting.smarimccarthy.is/#/election					
x Vestur	4	3	8091	6718	2066

## Settings

Divider for allocating constituency seats

Sainte-Laguë method

Which divider rule should be used to allocate constituency seats to lists within each constituency?

Divider for apportioning adjustment seats

D'Hondt's method

Which divider rule should be used to apportion adjustment seats among parties?

Divider for allocating adjustment seats

Sainte-Laguë method

Which divider rule should be used to allocate adjustment seats to individual lists?

Adjustment method

Relative Superiority Method

Which method should be used to allocate adjustment seats?

Adjustment threshold

0

%

What threshold are parties required to reach to qualify for adjustment seats?

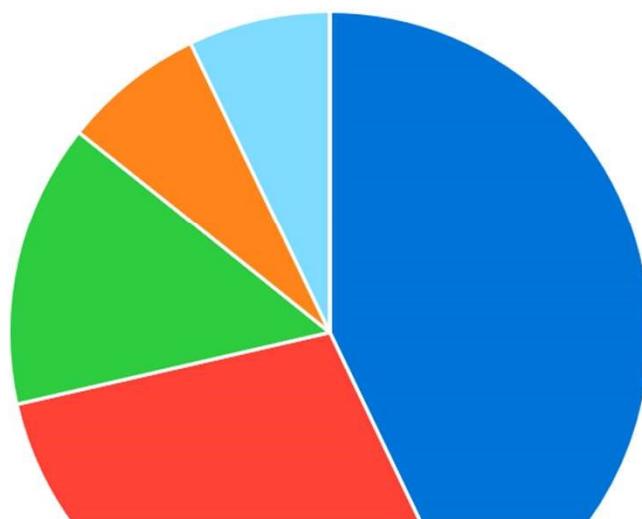
## Results

A	B	C	D	E

## Results

	A	B	C	D	E
Norður	3	2	1	1	0
Austur	4	2	1	0	0
Suður	2	2	1	1	1
Vestur	3	2	1	0	1
Total	12	8	4	2	2

■ A ■ B ■ C ■ D ■ E



Voting								Martha Guðrún
Vestur	4	3	8091	6718	2066	1796	1677	

## Settings

Divider for allocating constituency seats

D'Hondt's method

Adjustment method

Switching Method

Which divider rule should be used to allocate constituency seats to lists within each constituency?

Divider for apportioning adjustment seats

D'Hondt's method

Which method should be used to allocate adjustment seats?

Adjustment threshold

5

Which divider rule should be used to apportion adjustment seats among parties?

Divider for allocating adjustment seats

D'Hondt's method

Which divider rule should be used to allocate adjustment seats to individual lists?

%

What threshold are parties required to reach to qualify for adjustment seats?

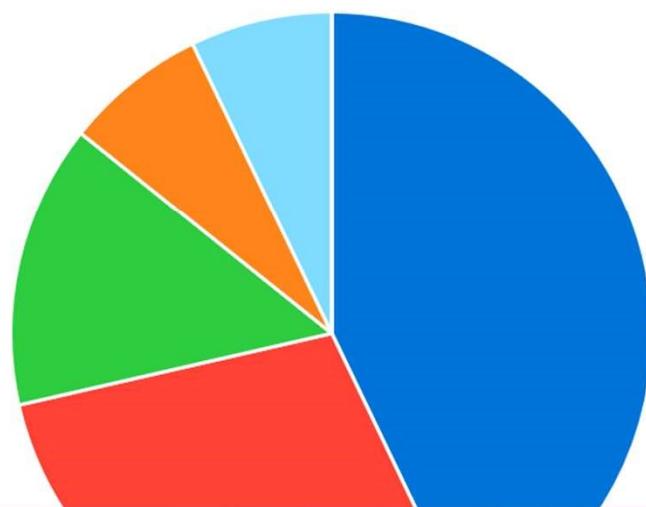
## Results

A	B	C	D	E

## Results

	A	B	C	D	E
<b>Norður</b>	3	2	1	1	0
<b>Austur</b>	4	2	1	0	0
<b>Suður</b>	2	2	1	1	1
<b>Vestur</b>	3	2	1	0	1
<b>Total</b>	12	8	4	2	2

■ A ■ B ■ C ■ D ■ E





Voting Instructions Single Election Simulate

# Simulate elections

## Settings

### Simulation settings

Number of simulations

1000

How many simulations should be run? (Minimum 2)

Generating method

Beta distribution

Which method should be used to generate votes?

# Simulate elections

Add election ruleset

Name

My test

Delete this ruleset

Give this rule set a name.

Divider for allocating constituency seats

D'Hondt's method

Adjustment method

Icelandic law 24/2000 (Kosningar til Alþingis)

Voting × Martha Guðrún

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### Add election ruleset

Name  Delete this ruleset

Give this rule set a name.

Divider for allocating constituency seats

Which divider rule should be used to allocate constituency seats to lists within each constituency?

Adjustment method

Which method should be used to allocate adjustment seats?

Divider for apportioning adjustment seats

Which divider rule should be used to apportion adjustment seats among parties?

Adjustment threshold  %

What threshold are parties required to reach to qualify for adjustment seats?

Divider for allocating adjustment seats

Which divider rule should be used to allocate adjustment seats to individual lists?

Voting × Martha Guðrún

Not secure | voting.smarimccarthy.is/#/simulate

Name Delete this ruleset

Atlantis Switching

Give this rule set a name.

Divider for allocating constituency seats

D'Hondt's method

Which divider rule should be used to allocate constituency seats to lists within each constituency?

Adjustment method

Switching Method

Which method should be used to allocate adjustment seats?

Divider for apportioning adjustment seats

D'Hondt's method

Which divider rule should be used to apportion adjustment seats among parties?

Adjustment threshold

5 %

What threshold are parties required to reach to qualify for adjustment seats?

Divider for allocating adjustment seats

D'Hondt's method

Which divider rule should be used to allocate adjustment seats to individual lists?

Voting × Martha Guðrún

Not secure | voting.smarimccarthy.is/#/simulate

## Reference votes

Reference votes are the votes that will be used as mean values for the statistical distribution in the simulation.

Add constituency   Add party   Clear votes   Reset everything   Upload votes   Paste input   Load preset   Save voteset

	# Cons.	# Adj.	x	A	x	B	x	C	x	D	x	E
x <b>Norður</b>	4	3		6817		4548		2638		1889		956
x <b>Austur</b>	4	3		8410		5739		3964		1139		859
x <b>Suður</b>	4	3		4360		3118		2067		1183		1266
x <b>Vestur</b>	4	3		8091		6718		2066		1796		1677

Start simulation

Run simulation to get results

Voting × Martha Guðrún

Not secure | voting.smarimccarthy.is/#/simulate

	# Cons.	# Adj.	x A	x B	x C	x D	x E
x <b>Norður</b>	4	3	6817	4548	2638	1889	956
x <b>Austur</b>	4	3	8410	5739	3964	1139	859
x <b>Suður</b>	4	3	4360	3118	2067	1183	1266
x <b>Vestur</b>	4	3	8091	6718	2066	1796	1677

[Stop simulation](#)

0.027146s/iter      215

## Results

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### Constituency seats

Atlantis RS										
A		B		C		D		E		
Average	Stddev	Average	Stddev	Average	Stddev	Average	Stddev	Average	Stddev	



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## Constituency seats

Atlantis RS

	A		B		C		D		E	
	Average	Stddev								
<b>Norður</b>	1.82	0.40	1.03	0.17	0.86	0.35	0.27	0.45	0.01	0.12
<b>Austur</b>	1.98	0.14	1.01	0.10	1.00	0.04	0.01	0.10	0.00	0.04
<b>Suður</b>	1.55	0.50	1.02	0.14	0.95	0.21	0.21	0.41	0.27	0.44
<b>Vestur</b>	1.88	0.34	1.47	0.50	0.35	0.48	0.17	0.38	0.13	0.34
<b>Total</b>	7.23	0.76	4.53	0.56	3.16	0.64	0.67	0.71	0.42	0.57

Atlantis Switching

	A		B		C		D		E	
	Average	Stddev								
<b>Norður</b>	2.17	0.41	1.21	0.40	0.54	0.50	0.08	0.27	0.00	0.04
<b>Austur</b>	2.03	0.23	1.08	0.28	0.88	0.32	0.00	0.00	0.00	0.00
<b>Suður</b>	1.98	0.30	1.15	0.36	0.78	0.42	0.03	0.17	0.06	0.24
<b>Vestur</b>	2.09	0.31	1.81	0.39	0.06	0.24	0.02	0.13	0.02	0.13
<b>Total</b>	8.27	0.64	5.25	0.72	2.26	0.76	0.13	0.35	0.08	0.28

## Adjustment seats

Voting × Martha Guðrún

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## Adjustment seats

**Atlantis RS**

	A		B		C		D		E	
	Average	Stddev								
<b>Norður</b>	1.15	0.49	0.93	0.35	0.20	0.40	0.57	0.50	0.15	0.36
<b>Austur</b>	1.32	0.52	1.14	0.42	0.33	0.47	0.14	0.35	0.06	0.23
<b>Suður</b>	1.00	0.58	0.87	0.38	0.11	0.31	0.44	0.50	0.58	0.49
<b>Vestur</b>	0.99	0.50	0.85	0.51	0.47	0.50	0.30	0.46	0.39	0.49
<b>Total</b>	4.47	0.84	3.80	0.65	1.10	0.65	1.45	0.62	1.18	0.60

**Atlantis Switching**

	A		B		C		D		E	
	Average	Stddev								
<b>Norður</b>	0.83	0.52	0.71	0.47	0.54	0.50	0.78	0.45	0.14	0.35
<b>Austur</b>	1.24	0.53	1.00	0.45	0.60	0.50	0.12	0.32	0.04	0.21
<b>Suður</b>	0.54	0.51	0.69	0.49	0.39	0.49	0.61	0.49	0.77	0.48
<b>Vestur</b>	0.83	0.54	0.69	0.53	0.47	0.50	0.49	0.50	0.53	0.52
<b>Total</b>	3.44	0.71	3.09	0.71	2.01	0.66	1.99	0.46	1.48	0.59

## Total seats

Voting × Martha Guðrún

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<b>Total</b>	3.44	0.71	3.09	0.71	2.01	0.66	1.99	0.46	1.48	0.59
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### Total seats

Atlantis RS										
	A		B		C		D		E	
	Average	Stddev								
<b>Norður</b>	2.97	0.41	1.96	0.35	1.06	0.26	0.84	0.37	0.17	0.37
<b>Austur</b>	3.30	0.53	2.15	0.43	1.33	0.47	0.15	0.36	0.06	0.24
<b>Suður</b>	2.55	0.51	1.89	0.41	1.06	0.24	0.65	0.48	0.85	0.37
<b>Vestur</b>	2.87	0.51	2.32	0.48	0.82	0.40	0.47	0.50	0.52	0.50
<b>Total</b>	11.70	0.72	8.33	0.65	4.26	0.59	2.12	0.45	1.60	0.52

Atlantis Switching										
	A		B		C		D		E	
	Average	Stddev								
<b>Norður</b>	3.00	0.50	1.92	0.43	1.08	0.38	0.86	0.43	0.14	0.35
<b>Austur</b>	3.27	0.54	2.08	0.42	1.49	0.50	0.12	0.32	0.04	0.21
<b>Suður</b>	2.52	0.52	1.84	0.47	1.17	0.41	0.64	0.49	0.83	0.47
<b>Vestur</b>	2.92	0.57	2.50	0.56	0.53	0.51	0.50	0.52	0.55	0.53
<b>Total</b>	11.71	0.73	8.34	0.66	4.27	0.60	2.12	0.46	1.56	0.58



## Quality measures

Adjustment method	Atlantis RS		Atlantis Switching	
	relative-superiority		switching	
	Average	Std. deviation	Average	Std. deviation
<b>Deviation in number of seats allocated by the tested method versus:</b>				
Allocation by the optimal method	0.5120	1.5332	1.5760	2.3305
Allocation by Icelandic Law	3.4160	2.6277	2.8880	2.6460
Adjustment seats apportioned nationally	0.0000	0.0000	0.0000	0.0000
Allocation as if all seats were constituency seats	3.0560	1.6475	4.4960	1.5795
Allocation as if all seats were adjustment seats	0.0040	0.0894	0.0000	0.0000
<b>Quality indices (generally 0 to 1, the lower the better):</b>				
Relative entropy deviation from optimal solution	0.0051	0.0207	0.0351	0.0691
Proportionality index according to Loosmore-Hanby (adjusted to biproportionality)	0.2157	0.0232	0.2246	0.0321
Scaled sum of squared deviation of list seats from biproportional seat shares (Sainte-Lague)	0.1097	0.0254	0.1204	0.0320
Maximum of the minimum seat value used (d'Hondt)	0.4593	0.0884	0.4664	0.0935
Scaled sum of positive deviation of list seats from biproportional seat shares (d'Hondt)	0.1708	0.0231	0.1837	0.0300

# Framhaldið, fróðleikur og umræða

Smári McCarthy o.fl.

## Hvað nú?

- Hugbúnaðurinn verður gerður aðgengilegur von bráðar með einhverju móti
- Tillögur, hugmyndir og vinnuframlag til endurbóta og viðbóta er vel þegið
- Viðræður við fundargesti

# Tenglar

- Netföng aðstandenda
  - Martha Guðrún Bjarnadóttir, [marthagudrun6@gmail.com](mailto:marthagudrun6@gmail.com)
  - Pétur Ólafur Aðalgeirsson, [peturoa1@gmail.com](mailto:peturoa1@gmail.com)
  - Smári McCarthy, [smarim@althingi.is](mailto:smarim@althingi.is)
  - Þorkell Helgason, [thorkellhelga@gmail.com](mailto:thorkellhelga@gmail.com)
- Aðgengi að hugbúnaðinum (til bráðbirgða)
  - <http://voting.smarimccarthy.is/#/simulate>

# Viðbótarefni (drög)

- Á vefsíðu landskjörstjórnar eru úrslit og greiningar á alþingiskosningum 2003-2013, t.d. sú fyrsta:  
<https://landskjor.is/media/frettir/Greining2003endurbaett2013.pdf>
- <http://www.aardal.info/celius-zigne/>  
<http://www.aardal.info/celius-zigne/> í fórum Þorkels Helgasonar er ýmislegt að finna um viðfangsefnið
  - Vefsíða hans: [thorkellhelga@gmail.com](mailto:thorkellhelga@gmail.com)
  - Grein í mbl.is 10. september 2018:  
[https://www.mbl.is/frettir/innlent/2018/09/10/hin\\_fullkomna\\_adferd\\_er\\_of\\_flokin/](https://www.mbl.is/frettir/innlent/2018/09/10/hin_fullkomna_adferd_er_of_flokin/)
  - Grein í Stjórnmál og stjórnsýsla:  
<http://www.irpa.is/article/view/b.2014.10.2.3>
- Norðmaður með svipað, en þó ekki hermun
  - <http://www.aardal.info/celius-zigne/>
- Afar fróðleg síða
  - <https://kosningasaga.wordpress.com/>