

# US Gymnastics Analysis

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## Introduction

## Methodology

## Simulations

### Female Athletes' Results

m\_0 sig\_0 k\_0 v\_0  
14.0574616 0.5891628 0.6657795 79.5576545

Table 1: Women’s Floor Exercise Simulation Results

Athlete	Golds	Silvers	Bronzes	Total Medals
SimBIL_USA	211	99	47	357
RebAND_BRA	56	64	49	169
KalLIN_USA	31	33	32	96
JesGAD_GBR	26	27	42	95
FlaSAR_BRA	25	28	28	81
JorCHI_USA	22	27	27	76
JadCAR_USA	24	20	26	70
ShiJON_USA	14	28	19	61
JosROB_USA	16	24	18	58
MarMAG_ITA	13	21	13	47

m\_0 sig\_0 k\_0 v\_0  
14.0574616 0.5891628 0.6657795 79.5576545

Table 2: Women’s Balance Beam Simulation Results

Athlete	Golds	Silvers	Bronzes	Total Medals
SimBIL_USA	24	11	10	45
YaqZHO_CHN	17	14	12	43
KonMCC_USA	13	9	11	33
YusOU_CHN	7	7	5	19
QinZHA_CHN	7	9	3	19
HuaLUO_CHN	2	3	5	10
LeaWON_USA	4	5	1	10
SunLEE_USA	2	2	6	10
SanWEV_NED	1	4	4	9
SkyBLA_USA	2	4	3	9

m\_0 sig\_0 k\_0 v\_0  
14.0574616 0.5891628 0.6657795 79.5576545

Table 3: Women’s Vault Simulation Results

Athlete	Gold	Silver	Bronze	Total Medals
SimBIL_USA	32	20	14	66
RebAND_BRA	18	16	16	50
JadCAR_USA	13	9	8	30
ShiJON_USA	11	6	10	27
SkyBLA_USA	3	8	9	20
OndACH_GBR	4	7	9	20
KonMCC_USA	2	10	7	19
ShoMIY_JPN	4	9	5	18
JorCHI_USA	4	4	10	18
JosROB_USA	5	6	5	16

m\_0 sig\_0 k\_0 v\_0  
14.0574616 0.5891628 0.6657795 79.5576545

Table 4: Women’s Uneven Bars Simulation Results

Athlete	Gold	Silver	Bronze	Total Medals
KayNEM_ALG	16	14	7	37
ShiJON_USA	10	8	9	27
QiyQIU_CHN	13	6	6	25
ZoeMIL_USA	6	8	8	22
RebAND_BRA	5	8	7	20
XijTAN_CHN	9	3	7	19
XiaWEI_CHN	4	8	3	15
AliD_A_ITA	5	4	5	14
EliSEI_GER	2	7	4	13
YunLEE_KOR	4	3	4	11

## Male Athletes’ Results

m\_0 sig\_0 k\_0 v\_0  
14.0574616 0.5891628 0.6657795 79.5576545

Table 5: Men’s Floor Exercise Simulation Results

Athlete	Gold	Silver	Bronze	Total Medals
CarYUL_PHI	12	11	4	27
ArtDOL_ISR	11	6	4	21
DaiHAS_JPN	4	5	8	17
RyoDOI_JPN	6	4	3	13
PauJUD_USA	3	6	3	12
ConMCC_USA	3	1	6	10
FreRIC_USA	2	4	4	10
NicBAR_ITA	6	3	0	9
ChiTAN_TPE	2	3	4	9
GiaREG_GBR	5	2	2	9

m\_0 sig\_0 k\_0 v\_0  
14.0574616 0.5891628 0.6657795 79.5576545

Table 6: Men’s Vault Simulation Results

Athlete	Golds	Silvers	Bronzes	Total Medals
JakJAR_GBR	19	15	8	42
AshHON_USA	17	7	8	32
DaiHAS_JPN	8	12	10	30
KhoYOU_USA	7	11	11	29
BohZHA_CHN	10	11	7	28
DonWHI_USA	9	11	5	25
CurPHI_USA	5	7	9	21
TayBUR_USA	4	5	10	19
DalHAL_USA	5	6	7	18
KamNEL_USA	2	6	8	16

m\_0 sig\_0 k\_0 v\_0  
14.0574616 0.5891628 0.6657795 79.5576545

Table 7: Men’s Pommel Horse Simulation Results

Athlete	Golds	Silvers	Bronzes	Total Medals
MaxWHI_GBR	13	11	12	36
ChiLEE_TPE	15	9	5	29
RhyMCC_IRL	8	8	7	23
NarKUR_KAZ	12	5	4	21
AhmSOU_JOR	4	8	8	20
Mc CLE_IRL	8	8	4	20
AhmABU_JOR	5	1	6	12
LorDE_NED	3	2	6	11
SteNED_USA	5	2	4	11
RhyMC_IRL	2	3	5	10

m\_0 sig\_0 k\_0 v\_0  
14.0574616 0.5891628 0.6657795 79.5576545

Table 8: Men’s High Bar Simulation Results

Athlete	Golds	Silvers	Bronzes	Total Medals
DaiHAS_JPN	9	9	9	27
BohZHA_CHN	12	6	7	25
WeiSUN_CHN	8	5	6	19
ConSHI_CHN	9	3	3	15
YuyKAM_JPN	5	7	2	14
BroMAL_USA	4	4	4	12
ArtMAR_BRA	4	5	3	12
WeiSU_CHN	1	4	7	12
JoeFRA_GBR	3	5	3	11
ShoKAW_JPN	4	3	3	10

m\_0 sig\_0 k\_0 v\_0  
14.0574616 0.5891628 0.6657795 79.5576545

Table 9: Men's Still Rings Simulation Results

Athlete	Gold	Silver	Bronze	Total Medals
XinLAN_CHN	15	10	11	36
YanLIU_CHN	14	12	6	32
ElePET_GRE	15	8	6	29
JinZOU_CHN	5	7	9	21
HaoYOU_CHN	6	6	0	12
BohZHA_CHN	2	6	4	12
AdeASI_TUR	5	5	2	12
NikSIM_AZE	1	3	8	12
IbrCOL_TUR	4	2	4	10
SalMAR_ITA	4	4	2	10

```

      m_0      sig_0      k_0      v_0
14.0574616  0.5891628  0.6657795 79.5576545

```

Table 10: Men's Parallel Bars Simulation Results

Athlete	Gold	Silver	Bronze	Total Medals
JinZOU_CHN	32	17	11	60
LukDAU_GER	12	7	5	24
BohZHA_CHN	4	6	8	18
JoeFRA_GBR	4	6	6	16
IllKOV_UKR	3	4	9	16
CurPHI_USA	4	4	7	15
BlaSUN_USA	4	7	3	14
ColWAL_USA	6	2	5	13
CarYUL_PHI	2	7	2	11
ConSHI_CHN	4	2	3	9

### Objective 1: Choice of Medal Metric

```

# A tibble: 1,060 x 9
  unique_id Golds Silvers Bronzes Total_Medals Country Medal_Weight Apparatus
  <chr>      <dbl>   <dbl>   <dbl>      <dbl> <fct>      <dbl> <chr>
1 SimBIL_USA  211     99     47        357 USA         878 FX
2 RebAND_BRA   56     64     49        169 BRA         345 FX
3 KallIN_USA   31     33     32         96 USA         191 FX
4 JesGAD_GBR   26     27     42         95 GBR         174 FX
5 FlaSAR_BRA   25     28     28         81 BRA         159 FX
6 JorCHI_USA   22     27     27         76 USA         147 FX
7 JadCAR_USA   24     20     26         70 USA         138 FX
8 ShiJON_USA   14     28     19         61 USA         117 FX
9 JosROB_USA   16     24     18         58 USA         114 FX
10 MarMAG_ITA  13     21     13         47 ITA          94 FX

```

```
# i 1,050 more rows
```

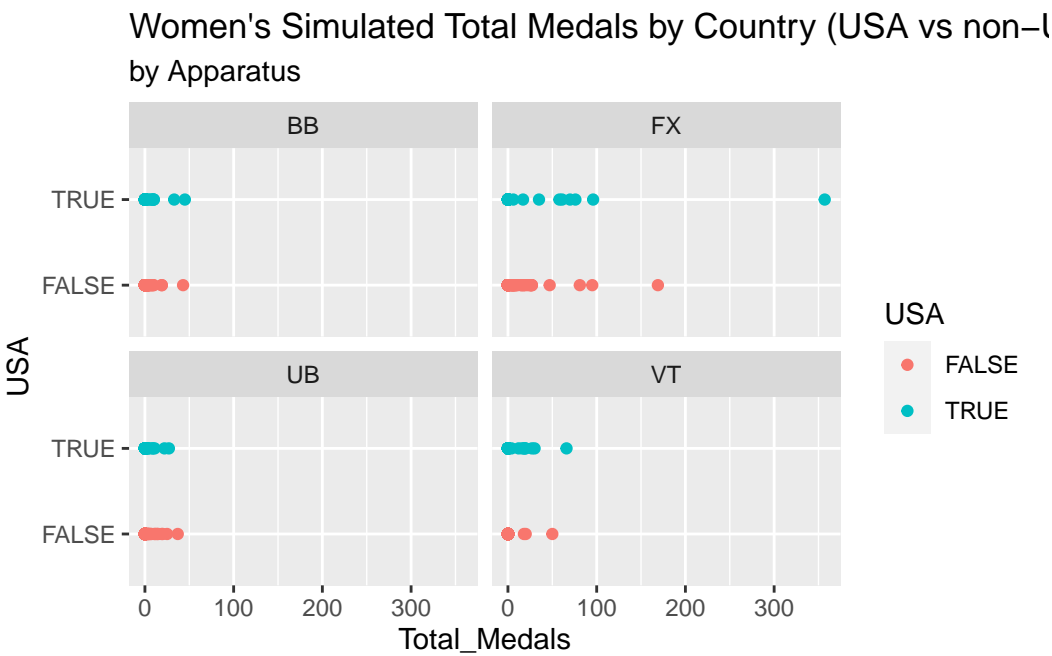
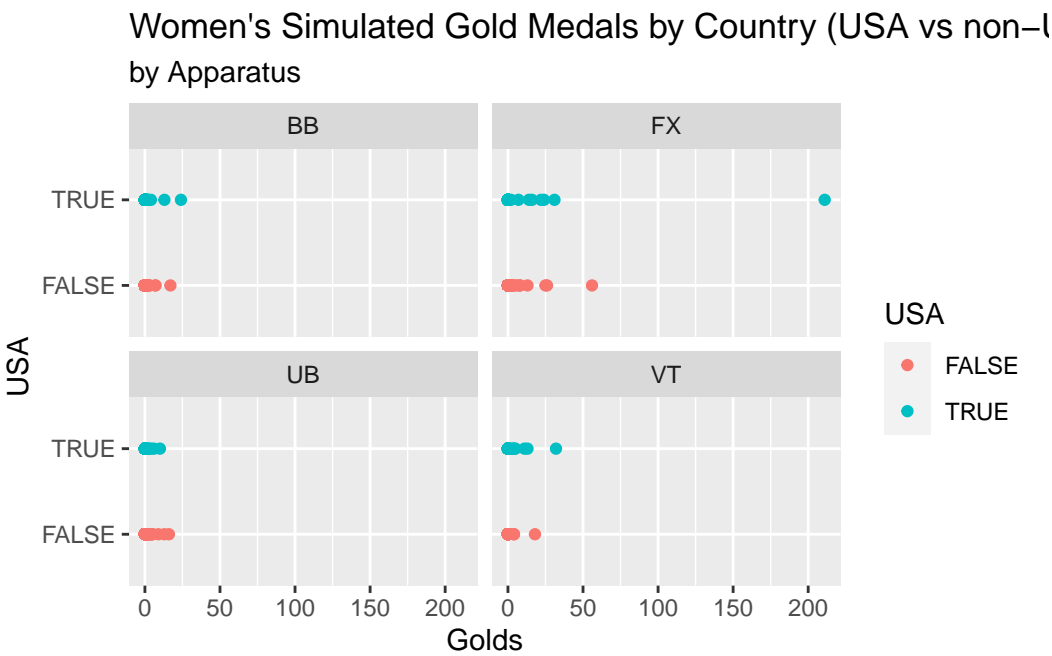
```
# i 1 more variable: USA <fct>
```

```

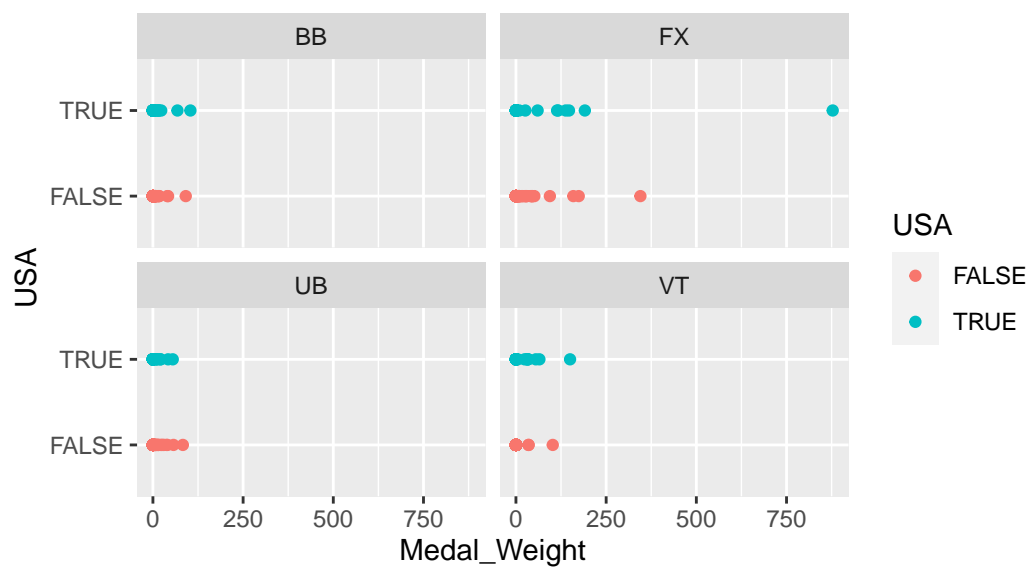
# A tibble: 1,590 x 9
  unique_id Golds Silvers Bronzes Total_Medals Country Medal_Weight Apparatus
  <chr>      <dbl>   <dbl>   <dbl>      <dbl> <fct>      <dbl> <chr>
1 CarYUL_PHI   12     11      4         27 PHI          62 FX
2 ArtDOL_ISR   11      6      4         21 ISR          49 FX

```

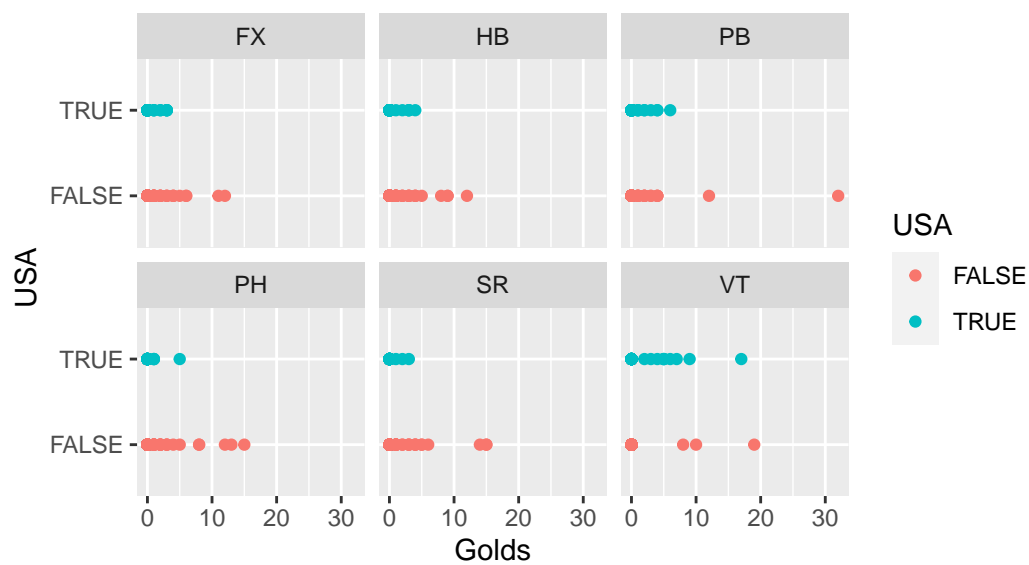
3 DaiHAS_JPN	4	5	8	17 JPN	30 FX
4 RyoDOI_JPN	6	4	3	13 JPN	29 FX
5 PauJUD_USA	3	6	3	12 USA	24 FX
6 ConMCC_USA	3	1	6	10 USA	17 FX
7 FreRIC_USA	2	4	4	10 USA	18 FX
8 NicBAR_ITA	6	3	0	9 ITA	24 FX
9 ChiTAN_TPE	2	3	4	9 TPE	16 FX
10 GiaREG_GBR	5	2	2	9 GBR	21 FX
# i 1,580 more rows					
# i 1 more variable: USA <fct>					



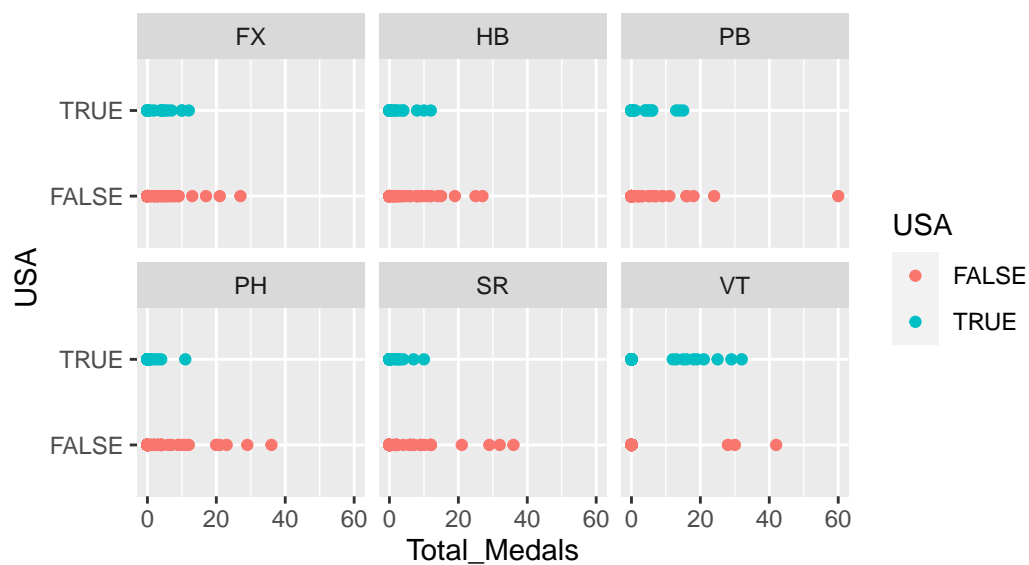
Women's Simulated Weighted Medals by Country (USA vs non-USA) by Apparatus



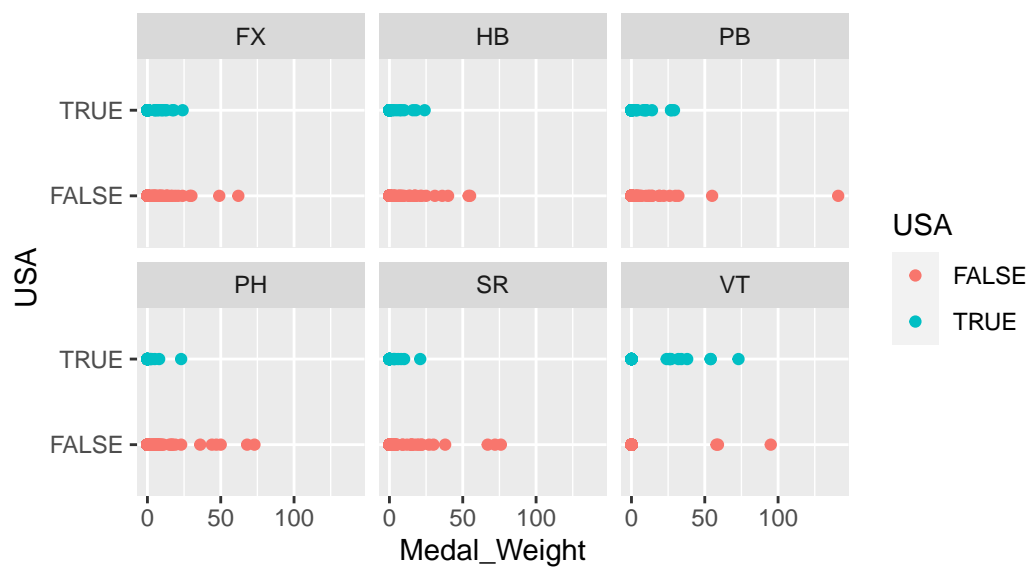
Men's Simulated Gold Medals by Country (USA vs non-USA) by Apparatus



Men's Simulated Total Medals by Country (USA vs non-USA) by Apparatus



Men's Simulated Weighted Medals by Country (USA vs non-USA) by Apparatus

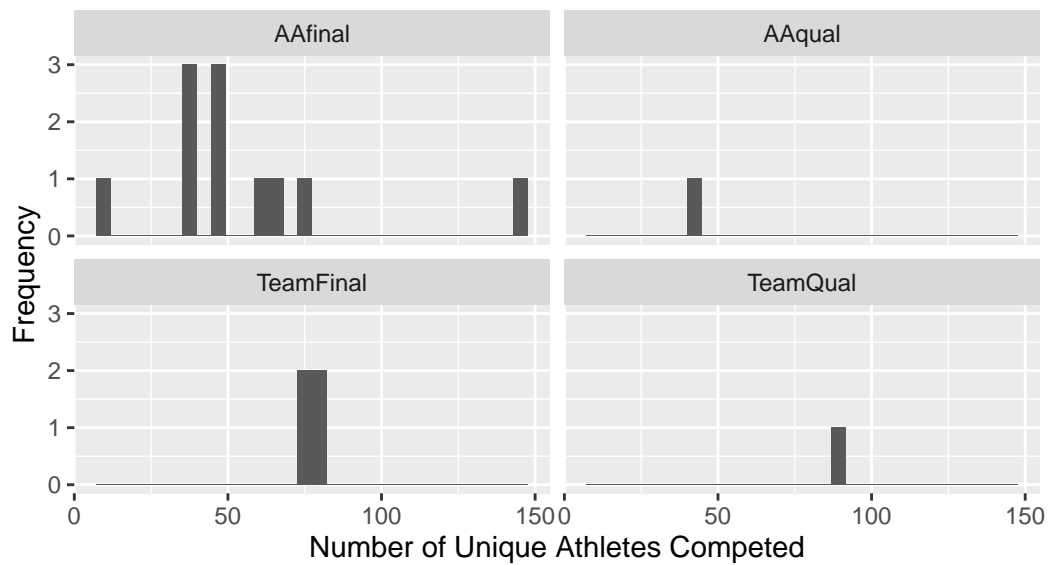


## Discussion

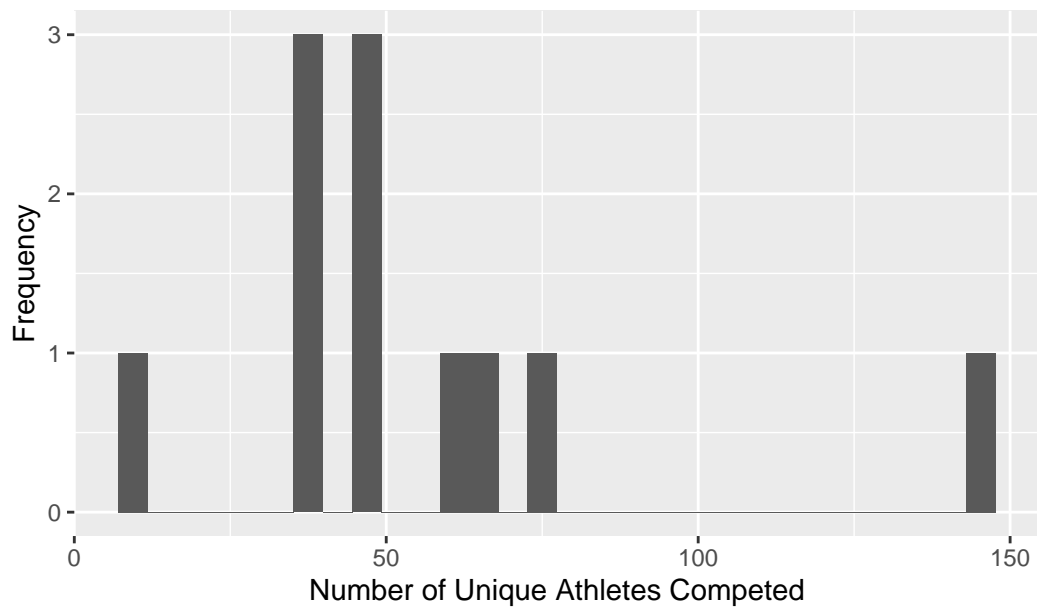
## Appendix

### 1) Distribution of Athletes Competed at Competition Rounds

All Around or Team All Arouns



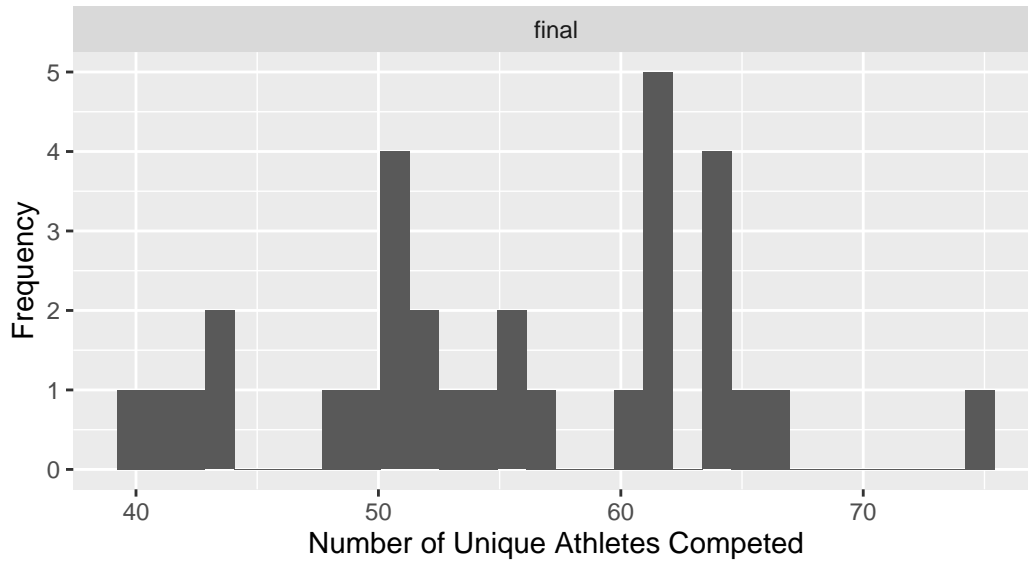
### 2) Distribution of Athletes Competed at AA Finals



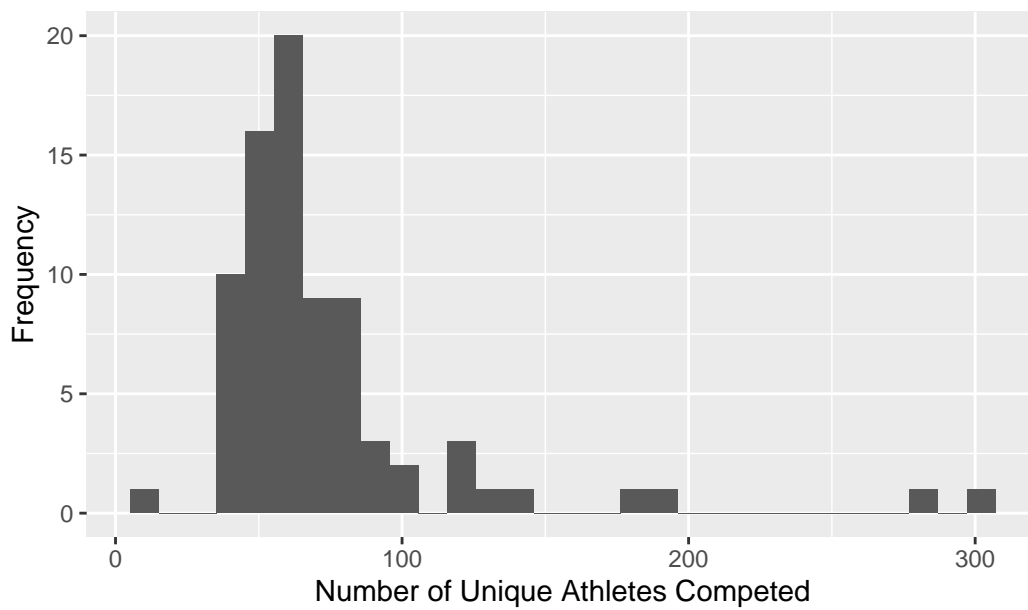


### 3) Distribution of Athletes Competed at Final Rounds

Individual Apparatuses

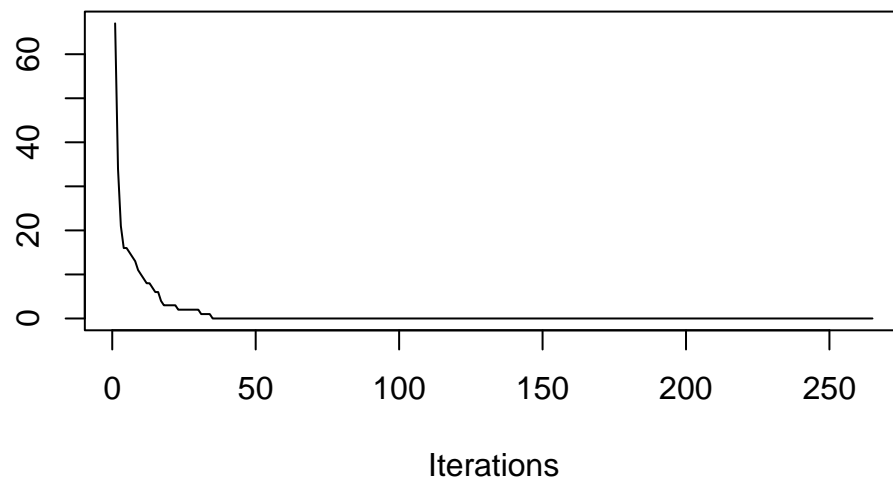


### 4) Distribution of Athletes Competed at Competitions

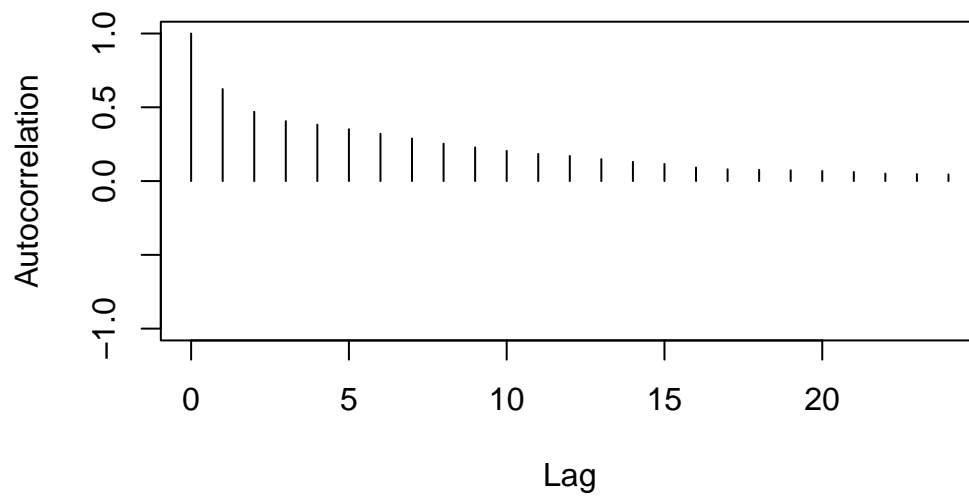


## Diagnostics

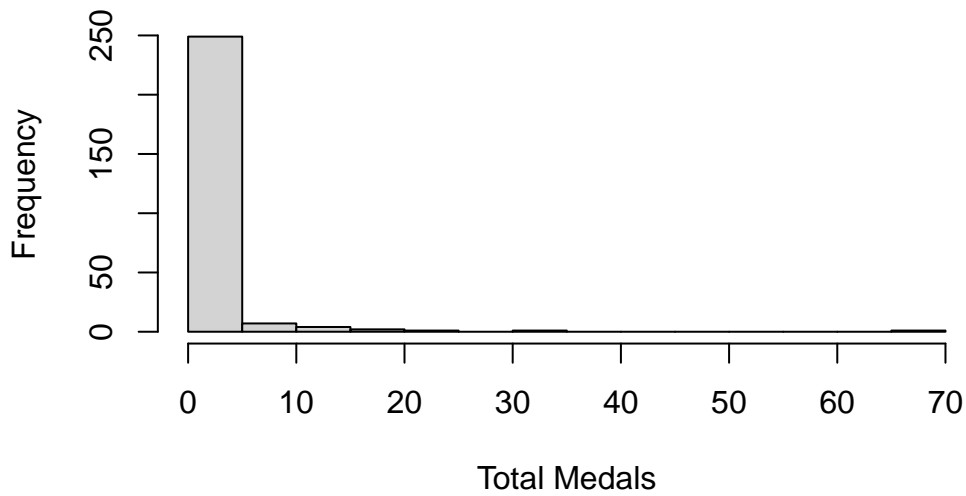
**Trace Plot of Total Medals**



var1  
29.54697



## Histogram of Total Medals



```
Iterations = 1:1060
Thinning interval = 1
Number of chains = 1
Sample size per chain = 1060
```

1. Empirical mean and standard deviation for each variable,  
plus standard error of the mean:

Mean	SD	Naive SE	Time-series SE
2.2642	14.5906	0.4481	1.3603

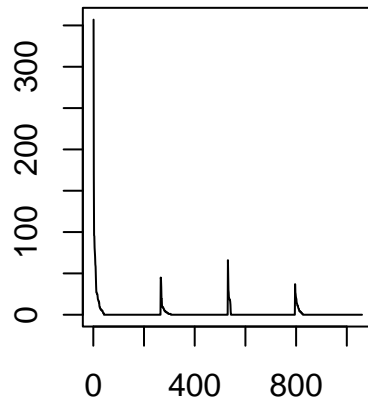
2. Quantiles for each variable:

2.5%	25%	50%	75%	97.5%
0	0	0	0	22

```
var1
0.06893296
```

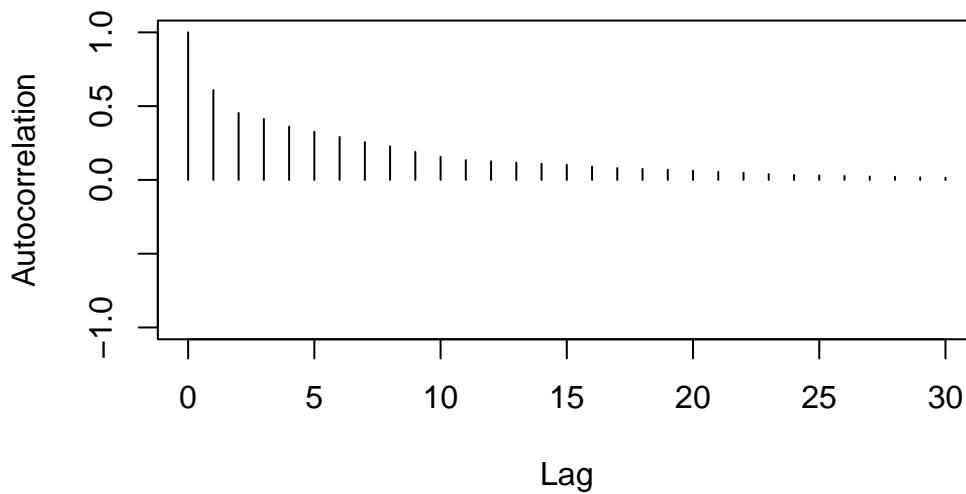
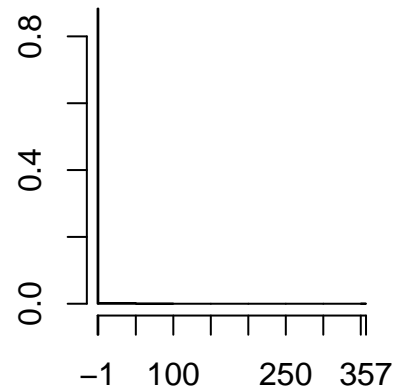
```
var1
115.0435
```

**Trace of var1**



Iterations

**Density of var1**



Iterations = 1:1590  
 Thinning interval = 1  
 Number of chains = 1  
 Sample size per chain = 1590

1. Empirical mean and standard deviation for each variable,  
 plus standard error of the mean:

Mean	SD	Naive SE	Time-series SE
1.1321	4.2520	0.1066	0.4052

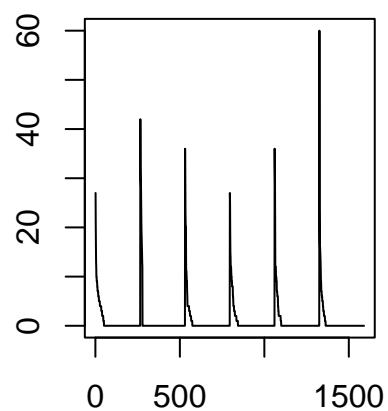
2. Quantiles for each variable:

2.5%	25%	50%	75%	97.5%
0	0	0	0	12

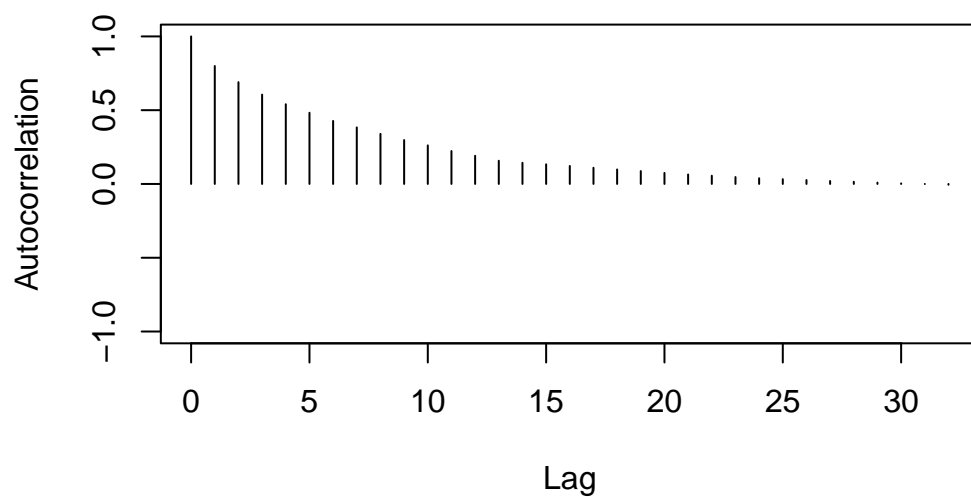
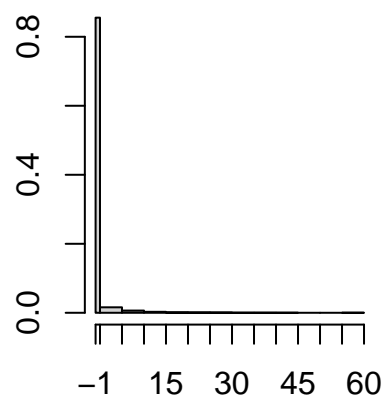
```
var1
0.05852738
```

```
var1
110.1097
```

**Trace of var1**



**Density of var1**



## Referenced in Results

```
# A tibble: 20 x 9
```

```
# Groups:   Apparatus [4]
  unique_id  Golds Silvers Bronzes Total_Medals Country Medal_Weight Apparatus
  <chr>      <dbl>   <dbl>   <dbl>      <dbl> <fct>      <dbl> <chr>
1 SimBIL_USA    24     11     10         45 USA         104 BB
2 YaqZHO_CHN    17     14     12         43 CHN          91 BB
3 KonMCC_USA    13      9     11         33 USA          68 BB
4 YusOU__CHN     7      7      5         19 CHN          40 BB
5 QinZHA_CHN     7      9      3         19 CHN          42 BB
6 SimBIL_USA   211     99     47        357 USA        878 FX
7 RebAND_BRA    56     64     49        169 BRA        345 FX
8 KallIN_USA    31     33     32         96 USA         191 FX
9 JesGAD_GBR    26     27     42         95 GBR         174 FX
10 FlaSAR_BRA   25     28     28         81 BRA         159 FX
11 KayNEM_ALG   16     14      7         37 ALG          83 UB
12 QiyQIU_CHN   13      6      6         25 CHN          57 UB
13 ShiJON_USA   10      8      9         27 USA          55 UB
14 XijTAN_CHN    9      3      7         19 CHN          40 UB
15 ZoeMIL_USA    6      8      8         22 USA          42 UB
16 SimBIL_USA   32     20     14         66 USA         150 VT
17 RebAND_BRA   18     16     16         50 BRA         102 VT
18 JadCAR_USA   13      9      8         30 USA          65 VT
19 ShiJON_USA   11      6     10         27 USA          55 VT
20 JosROB_USA    5      6      5         16 USA          32 VT

# i 1 more variable: USA <fct>
```

```
# A tibble: 21 x 9
```

```
# Groups:   Apparatus [4]
  unique_id  Golds Silvers Bronzes Total_Medals Country Medal_Weight Apparatus
  <chr>      <dbl>   <dbl>   <dbl>      <dbl> <fct>      <dbl> <chr>
1 SimBIL_USA    24     11     10         45 USA         104 BB
2 YaqZHO_CHN    17     14     12         43 CHN          91 BB
3 KonMCC_USA    13      9     11         33 USA          68 BB
4 YusOU__CHN     7      7      5         19 CHN          40 BB
5 QinZHA_CHN     7      9      3         19 CHN          42 BB
6 SimBIL_USA   211     99     47        357 USA        878 FX
7 RebAND_BRA    56     64     49        169 BRA        345 FX
8 KallIN_USA    31     33     32         96 USA         191 FX
9 JesGAD_GBR    26     27     42         95 GBR         174 FX
10 FlaSAR_BRA   25     28     28         81 BRA         159 FX

# i 11 more rows
# i 1 more variable: USA <fct>
```

```
# A tibble: 21 x 9
```

```
# Groups:   Apparatus [4]
  unique_id  Golds Silvers Bronzes Total_Medals Country Medal_Weight Apparatus
  <chr>      <dbl>   <dbl>   <dbl>      <dbl> <fct>      <dbl> <chr>
1 SimBIL_USA    24     11     10         45 USA         104 BB
2 YaqZHO_CHN    17     14     12         43 CHN          91 BB
3 KonMCC_USA    13      9     11         33 USA          68 BB
4 QinZHA_CHN     7      9      3         19 CHN          42 BB
5 YusOU__CHN     7      7      5         19 CHN          40 BB
```

```

6 SimBIL_USA    211      99      47      357 USA      878 FX
7 RebAND_BRA    56       64      49      169 BRA      345 FX
8 KallIN_USA    31       33      32       96 USA      191 FX
9 JesGAD_GBR    26       27      42       95 GBR      174 FX
10 FlaSAR_BRA   25       28      28       81 BRA      159 FX

```

```

# i 11 more rows
# i 1 more variable: USA <fct>

```

```

# A tibble: 2 x 2

```

```

  USA    sumGolds
  <fct>    <dbl>
1 FALSE     324
2 TRUE      476

```

```

# A tibble: 2 x 2

```

```

  USA    sumTot
  <fct>    <dbl>
1 FALSE   1195
2 TRUE    1205

```

```

# A tibble: 2 x 2

```

```

  USA    sumWeighted
  <fct>    <dbl>
1 FALSE    2250
2 TRUE     2550

```

**Image 5)** For the women's simulation when looking at the top 5 athletes by:

*Gold Medal Count* for each apparatus there are 11 out of 20 from the US: balance beam (BB): 2, floor exercise (FX): 3, uneven bars (UB): 2, and vault (VT): 4

USA makes up 58% of the total women's gold medals in the simulation.

*Total Medal Count* for each apparatus there are 10 out of 20 from the US: balance beam (BB): 2, floor exercise (FX): 2, uneven bars (UB): 2, vault (VT): 4

USA makes up 49% of the total women's medals in the simulation.

*Weighted Medal Count* for each apparatus there are 9 out of 20 from the US: balance beam (BB): 2, floor exercise (FX): 2, uneven bars (UB): 2, vault (VT): 3

USA makes up 52% of the weight of women's medals in the simulation.

```

# A tibble: 34 x 9

```

```

# Groups:   Apparatus [6]

```

```

  unique_id Golds Silvers Bronzes Total_Medals Country Medal_Weight Apparatus
  <chr>      <dbl>   <dbl>   <dbl>      <dbl> <fct>      <dbl> <chr>
1 CarYUL_PHI    12     11      4          27 PHI         62 FX
2 ArtDOL_ISR    11      6      4          21 ISR         49 FX
3 RyoDOI_JPN     6      4      3          13 JPN         29 FX
4 NicBAR_ITA     6      3      0           9 ITA         24 FX
5 GiaREG_GBR     5      2      2           9 GBR         21 FX
6 BohZHA_CHN    12      6      7          25 CHN         55 HB

```

7 DaiHAS_JPN	9	9	9	27 JPN	54 HB
8 ConSHI_CHN	9	3	3	15 CHN	36 HB
9 WeiSUN_CHN	8	5	6	19 CHN	40 HB
10 YuyKAM_JPN	5	7	2	14 JPN	31 HB

# i 24 more rows

# i 1 more variable: USA <fct>

# A tibble: 34 x 9

# Groups: Apparatus [6]

	unique_id	Gold	Silver	Bronze	Total_Medals	Country	Medal_Weight	Apparatus
	<chr>	<dbl>	<dbl>	<dbl>	<dbl>	<fct>	<dbl>	<chr>
1	CaryUL_PHI	12	11	4	27	PHI	62	FX
2	ArtDOL_ISR	11	6	4	21	ISR	49	FX
3	DaiHAS_JPN	4	5	8	17	JPN	30	FX
4	RyoDOI_JPN	6	4	3	13	JPN	29	FX
5	PauJUD_USA	3	6	3	12	USA	24	FX
6	DaiHAS_JPN	9	9	9	27	JPN	54	HB
7	BohZHA_CHN	12	6	7	25	CHN	55	HB
8	WeiSUN_CHN	8	5	6	19	CHN	40	HB
9	ConSHI_CHN	9	3	3	15	CHN	36	HB
10	YuyKAM_JPN	5	7	2	14	JPN	31	HB

# i 24 more rows

# i 1 more variable: USA <fct>

# A tibble: 32 x 9

# Groups: Apparatus [6]

	unique_id	Gold	Silver	Bronze	Total_Medals	Country	Medal_Weight	Apparatus
	<chr>	<dbl>	<dbl>	<dbl>	<dbl>	<fct>	<dbl>	<chr>
1	CaryUL_PHI	12	11	4	27	PHI	62	FX
2	ArtDOL_ISR	11	6	4	21	ISR	49	FX
3	DaiHAS_JPN	4	5	8	17	JPN	30	FX
4	RyoDOI_JPN	6	4	3	13	JPN	29	FX
5	PauJUD_USA	3	6	3	12	USA	24	FX
6	NicBAR_ITA	6	3	0	9	ITA	24	FX
7	BohZHA_CHN	12	6	7	25	CHN	55	HB
8	DaiHAS_JPN	9	9	9	27	JPN	54	HB
9	WeiSUN_CHN	8	5	6	19	CHN	40	HB
10	ConSHI_CHN	9	3	3	15	CHN	36	HB

# i 22 more rows

# i 1 more variable: USA <fct>

# A tibble: 2 x 2

	USA	sumGolds
	<fct>	<dbl>
1	FALSE	464
2	TRUE	136

# A tibble: 2 x 2

	USA	sumTot
	<fct>	<dbl>
1	FALSE	1350
2	TRUE	450



```
# A tibble: 2 x 2
  USA    sumWeighted
  <fct>    <dbl>
1 FALSE    2738
2 TRUE     862
```

**Image 6)** For the men's simulation when looking at the top 5 athletes by:

*Gold Medal Count* for each apparatus there are 5 out of 30 from the US: floor exercise (FX): 0, high bar (HB): 0, parallel bars (PB): 3 pommel horse (PH): 0, still rings (SR): 0, vault (VT): 2

USA makes up 23% of the total men's gold medals in the simulation.

*Total Medal Count* for each apparatus there are 3 out of 30 from the US: floor exercise (FX): 1, high bar (HB): 0, parallel bars (PB): 0, pommel horse (PH): 0, still rings (SR): 0, vault (VT): 2

USA makes up 25% of the total men's medals in the simulation.

*Weighted Medal Count* for each apparatus there are 5 out of 30 from the US: floor exercise (FX): 1, high bar (HB): 0, parallel bars (PB): 1, pommel horse (PH): 0, still rings (SR): 0, vault (VT): 3

USA makes up 24% of the weight of men's medals in the simulation.