US Gymnastics Analysis

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Introduction

Context and Background

The Olympic Games are a highly anticipated world-renowned multi-sporting event that takes place every four years. Particularly the Summer Olympic Games tend to have a wider variety of 32 sports and more viewers than that of the Winter Olympics (Olympics, 2021). Athletes from all over the world can participate granted they meet the criteria established by their nation's Olympic committees and the international sports federations. With female qualifying gymnasts from the United States placing with medals in the team all-around, individual all-around, and each individual apparatus in the 2020 Tokyo Olympics game, there has been a surge in media attention on the United States gymnastics teams. (Olympics, 2020)

As the Paris 2024 Summer Olympic Games is approaching, the United States Olympic Men's and Women's Artistic Gymnastics aims to put together a team that best represents the country on the world's sporting stage by optimizing medal success amongst the team all-around, individual all-around, and individual apparatus events. This study aims to use the most recent Olympic Games and other world competitions' qualifying and final round results data to best assemble a team that is likely to produce optimal success in terms of medals within the Olympic qualifiers and final criteria. (UCSAS, 2023)

These are our main objectives for this study: (UCSAS, 2023)

1) Decide on whether to maximize total medal count, gold medal count, or a weighted medal count (e.g., 3 for gold, 2 for silver, 1 for bronze).
2) Decide on whether to value the medals of an event over others. For example, consider a team all-around medal to be more valuable than the individual all-around medals and/or consider the individual all-around medals to be more valuable than the individual apparatus medals.
3) Decide on whether Team USA should maximize its total medal count by selecting a team of five gymnasts who are all-around gymnasts, event specialists (gymnasts who focus on 1 or more apparatus but not all apparatus), or a combination of those. This should consider under what circumstances can Team USA maximize its total medal count by selecting a gymnast who only competes on 1 apparatus (e.g., Stephen Nederoscik, 2021 pommel horse World Champion).
4) Identify the group of five athletes who will most likely enable the Team USA Olympic Men's and Women's Artistic Gymnastics team to maximize medals won in the Paris 2024 Summer Olympics using an analytical model.

Addressing these objectives will assist the national Olympic Artistic Gymnastics teams in best approaching the Olympic gymnastics events in totality by offering recommended strategies to best approach team selection.

The Data

The UConn Sports Analytics Symposium provisioned a clean data set of the accumulation of results of teams worldwide that participated in the major domestic and international gymnastic qualifying and final competition events leading up to the 2024 Summer Olympic Games. These competitions took place in the 2022 and 2023 gymnastics seasons. The UConn Sports Analytics Symposium also provides a clean data set of the results of all the women's artistic gymnastics teams that participated in the 2020 Tokyo Summer Olympics qualifying and final events. Both datasets are at the individual athlete, competition, apparatus, and round level. The data of the recorded results for each competition for both men and women gymnasts were collected and manually input from the official corresponding competitions' website results after the judging of each competition.

The columns for both datasets include LastName, Firstname, Gender, Country, Data, Competition, Round ("TeamQual": team all-around qualifiers, "TeamFinal": team all-around finals, "AAqual": individual all-around qualifiers, "AAfinal": individual all-around finals, "qual": individual apparatus qualifiers, "final": individual apparatus finals), Location, Apparatus ("BB": balance beam, "FX": floor exercise, "HB": high bar, "PB": parallel bars, "PH": pommel horse, "SR": still rings, "UB": uneven bars, "VT": vault, "VT1" and "VT2": 2 different vaults required in individual apparatus qualifications and finals), Rank, D_Score (difficulty score), E_Score (execution score), Penalty (score deduction for breaking event criteria), and Score (D_Score + E_Score - Penalty).

We decided to not proceed in using the data set of results from the 2020 Tokyo Summer Olympics since the data consisted only of female athletes and one competition (the Olympic Games). Also in the context of Olympic gymnastics, athletes of age 16 and older are eligible to compete but gymnastics is a sport in which most athletes retire in their early to mid-twenties. Specifically in the summer 2020 Tokyo Olympics only three female athletes aged 27 or older qualified to compete (Camenker, 2021). Furthermore, the average age for female gymnasts in the 2020 Olympics was approximately 22 years of age, meaning we assume that many of the competitors in the older data set will not be competing in the 2024 Paris Summer Olympics (Meyers, 2021).

Methodology

EDA ...

Simulations

Female Athletes' Results

Table 1: Women's Floor Exercise Simulation Results

Athlete	Golds	Silvers	Bronzes	Total Medals
SimBIL_USA	192	76	70	338
RebAND_BRA	58	54	44	156
JesGAD_GBR	28	48	36	112
KalLIN_USA	38	35	36	109
JadCAR_USA	14	28	25	67
FlaSAR_BRA	21	26	19	66
JorCHI_USA	21	22	21	64
MarMAG_ITA	15	26	19	60
YusOU___CHN	8	19	21	48
JosROB_USA	7	16	21	44

Table 2: Women's Balance Beam Simulation Results

Athlete	Golds	Silvers	Bronzes	Total Medals
YaqZHO_CHN	93	66	50	209
SimBIL_USA	99	61	47	207
KonMCC_USA	67	54	40	161
QinZHA_CHN	48	53	41	142
SunLEE_USA	28	27	30	85
YusOU___CHN	19	30	29	78
SkyBLA_USA	12	17	25	54
HuaLUO_CHN	17	18	16	51
UraASH_JPN	14	10	14	38
LeaWON_USA	9	11	10	30

Table 3: Women's Vault Simulation Results

Athlete	Golds	Silvers	Bronzes	Total Medals
SimBIL_USA	178	85	74	337
RebAND_BRA	114	91	68	273
JadCAR_USA	74	80	59	213
ShiJON_USA	16	46	50	112
JorCHI_USA	16	29	59	104
KonMCC_USA	18	35	32	85
OndACH_GBR	20	31	29	80
JosROB_USA	12	36	26	74
ShoMIY_JPN	19	21	32	72
TiaSUM_USA	14	22	30	66

Table 4: Women's Uneven Bars Simulation Results

Athlete	Golds	Silvers	Bronzes	Total Medals
KayNEM_ALG	102	69	41	212
QiyQIU_CHN	77	52	59	188
ShiJON_USA	55	50	52	157
XiaWEI_CHN	45	33	31	109
AliD A_ITA	24	44	39	107
ZoeMIL_USA	34	27	21	82
RebAND_BRA	21	31	21	73
XijTAN_CHN	20	28	25	73
EliSEI_GER	8	18	25	51
SimBIL_USA	15	18	12	45

Male Athletes' Results

Table 5: Men's Floor Exercise Simulation Results

Athlete	Golds	Silvers	Bronzes	Total Medals
CarYUL_PHI	77	47	30	154
ArtDOL_ISR	36	31	30	97
RyoDOI_JPN	33	25	25	83
BohZHA_CHN	17	27	15	59
PauJUD_USA	22	18	17	57
DaiHAS_JPN	19	19	18	56
KazMIN_JPN	12	18	19	49
YulMOL_USA	14	12	15	41
NicBAR_ITA	12	14	15	41
HarHEP_GBR	15	11	14	40

Table 6: Men's Vault Simulation Results

Athlete	Golds	Silvers	Bronzes	Total Medals
JakJAR_GBR	106	74	51	231
AshHON_USA	61	52	55	168
DaiHAS_JPN	60	55	48	163
BohZHA_CHN	59	45	36	140
DalHAL_USA	35	44	41	120
KhoYOU_USA	37	32	38	107
DonWHI_USA	26	46	33	105
CurPHI_USA	22	37	44	103
TayBUR_USA	24	28	42	94
ColWAL_USA	24	30	35	89

Table 7: Men's Pommel Horse Simulation Results

Athlete	Golds	Silvers	Bronzes	Total Medals
MaxWHI_GBR	70	53	38	161
Mc CLE_IRL	69	42	38	149
ChiLEE_TPE	41	45	41	127
NarKUR_KAZ	39	34	33	106
RhyMCC_IRL	35	31	28	94
AhmSOU_JOR	29	33	17	79
AhmABU_JOR	17	16	25	58
RhyMC _IRL	16	15	20	51
SteNED_USA	14	15	17	46
GagKHA_ARM	13	12	18	43

Table 8: Men's High Bar Simulation Results

Athlete	Golds	Silvers	Bronzes	Total Medals
DaiHAS_JPN	63	44	48	155
BohZHA_CHN	47	56	20	123
ConSHI_CHN	50	29	32	111
BroMAL_USA	26	30	25	81
MilKAR_KAZ	21	18	31	70
WeiSUN_CHN	25	30	11	66
ShoKAW_JPN	24	17	19	60
WeiSU___CHN	20	20	20	60
IliGEO_CYP	11	22	12	45
ChaLIN_CHN	16	16	10	42

Table 9: Men's Still Rings Simulation Results

Athlete	Golds	Silvers	Bronzes	Total Medals
YanLIU_CHN	82	49	30	161
XinLAN_CHN	54	47	56	157
JinZOU_CHN	41	36	31	108
ElePET_GRE	38	36	24	98
AdeASI_TUR	28	37	26	91
HaoYOU_CHN	27	23	25	75
SalMAR_ITA	21	20	27	68
IbrCOL_TUR	11	22	23	56
DonWHI_USA	21	21	14	56
NikSIM_AZE	13	14	29	56

Table 10: Men's Parallel Bars Simulation Results

Athlete	Golds	Silvers	Bronzes	Total Medals
JinZOU_CHN	175	82	48	305
LukDAU_GER	53	50	46	149
BohZHA_CHN	28	34	26	88
CarYUL_PHI	23	20	34	77
IllKOV_UKR	17	28	23	68
ColWAL_USA	16	25	26	67
JoeFRA_GBR	13	18	34	65
CurPHI_USA	21	23	15	59
KaiSUG_JPN	19	13	24	56
BlaSUN_USA	15	18	14	47

Objective 1: Choice of Medal Success Metric (Total Number of Gold Medals)

From the dotplot visualizations of the women's simulation of the three considered success metrics (gold medal count, total medal count, and weighted medal count) for each apparatus by USA and non-USA teams, there looks to be at least one USA athlete that places higher than of all non-USA athletes in each medal metric for each apparatus except uneven bars (Appendix: Image 5). The women's USA team makes up 58% of the total women's gold medals in the simulation which is a higher proportion than the 49% of the total medal count and 52% of the weighted medals (Appendix: Image 7). From the dotplot visualizations of the men's simulation of the three considered success metrics, for each apparatus by USA and non-USA teams, there are non-USA athletes for each apparatus that exceed the USA in each medal success metric (Appendix: Image 6). The men's USA team makes up 25% of the total medal count in the simulation which is a higher proportion than the 23% of the total gold medal count and 24% of the weighted medals. (Appendix: Image 8) When viewing the top 5 most successful female athletes (top 5 most decorated by that medal metric) in each apparatus for each medal success metric, the USA makes a good portion of these athletes. There tend to be 2-4 USA athletes in the top 5 depending on the success metric and apparatus (Appendix: Image 7). When viewing the top 5 most successful male athletes in each apparatus for each medal success metric, there tends to be 0-3 (mostly 0) US male athletes present (Appendix: Image 8).

Considering that female USA athletes tend to represent a much higher proportion of medal successes (no matter the success metric) than male USA athletes, it is best to prioritize the success metric that the female team performs the best in. Therefore, the success metric that we aim to maximize to best ensure the USA team's success is the total number of gold medals.

Objective 2: Value of Medals for Each Event Type (Team AA > Individual AA > Individual Apparatus)

From the table of the top 10 most decorated gold medal female athletes by apparatus, the USA, China, Brazil, and Great Britain make multiple appearances. The USA has athletes in the top 10 most decorated gold medalist for each apparatus as well as the top 5, but other countries do not (Appendix: Image 9). This allows us to assume that the USA has great potential in winning the team all-around since it is the only country with many of the most successful athletes in each apparatus in terms of number of gold medals. In this case valuing the team all-around medal more than the individual all-around and individual apparatus will hopefully increase medal success in terms of gold medal count. Also when viewing the top 10 most decorated gold medal female athletes by apparatus, the USA's Simone Biles, appears in balance beam as first, in floor exercise as first, in uneven bars tied at eighth highest, and vault as first. Valuing individual all-around higher also may help team USA increase in our metric of success. Also, since these events are harder to achieve than individual apparatuses because of the multiple sections within the event that need to also meet a standard, it will be harder for other countries to also benefit from this increased value.

From the table of the top 10 most decorated gold medal male athletes by apparatus, the USA, Japan, China, and Great Britain make multiple appearances. The only countries that have an athlete in each apparatus for

the top 10, are the USA and Great Britain (Appendix: Image 11). Since Great Britain has 1-2 (mostly 1) highly decorated gold medalist in the top 10 rankings for each apparatus and the US tends to have more, it could be slightly beneficial to the men's team to value the team all-around success more than the other events. The US men's team also does not have a well rounded athlete that places in the top 10 most decorated gold male athletes for each apparatus so we can assume valuing individual all-around successes over the other events would not help the US men's team but it also would not hurt it since other countries also do not have a highly decorated well rounded competitor.

In the dot plots of the top 5 decorated gold medal female athlete's unique ids by number of gold medals for each apparatus, US athletes make multiple appearances (Appendix: Image 10). In the dot plots of the top 5 decorated gold medal male athlete's unique ids by number of gold medals for each apparatus, the US athletes are only present in vault and parallel bars (Appendix: Image 12). Valuing individual apparatus events as a regular event of weight 1 would best suite both the male and female team's success against their competitors. Weighing the team-all around as 3 points is viable because not only do both the men and women's USA have the potential to win based on this simulation, but there is less of a reliance and pressure on one singular person. Weighing the individual all-around as 2 will hopefully benefit the women's team with Simone Biles as the potential representative for this event. These weights will hopefully best accommodate the male and female athletes and give them the best chance at success against other countries in terms of the total number of gold medals.

Objective 3: All-Around vs Event Specialist vs Mixture

In our metric of success we chose the total count of gold medals and we decided to weigh team all-around events greater than individual all-around events and individual all-around great than the individual apparatuses. For the women's team we believe it is best to select a team of five female athletes that are a combination of all-around and event specialist gymnasts. Since the US women's team has a strong shot at winning the individual all-around with multi-apparatus highly gold medal decorated athlete Simone Biles and team all-around with other multiple highly decorated gold medalists who specialize in their own apparatus, focusing on both would be an optimal strategy (Appendix: Image 10). For the men's team we believe it is best to select a team of five male atheletes are also a combination of both all-around gymnasts and specialists. In the simulatiom, since 4 of the top 10 most gold medal decorated male gymnasts in parallel bars are from the US and 7 of the top 10 in vault are from the US, there is a good chance that a male athlete from the US may be successful in those apparatuses (Appendix: Image 11). Since the US does not seem to have very many strong gold medal specialists in the other apparatuses, the men's team should fill the remaining positions with all-around gymnasts.

Objective 4: Identifying 5 Athletes ...

Discussion

Appendix

Work Cited

- "Paris 2024 Olympic Games: How Do Athletes Qualify?" Olympics, 8 Aug. 2021, olympics.com/en/news/paris-2024-olympic-games-how-do-athletes-qualify. Accessed 20 Nov. 2023.
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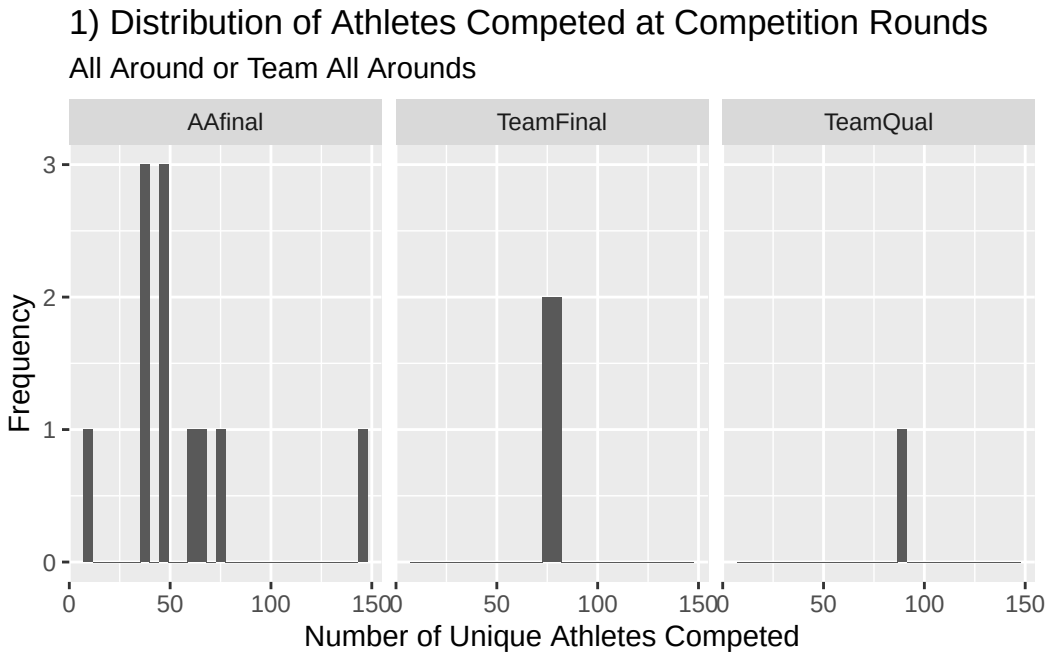
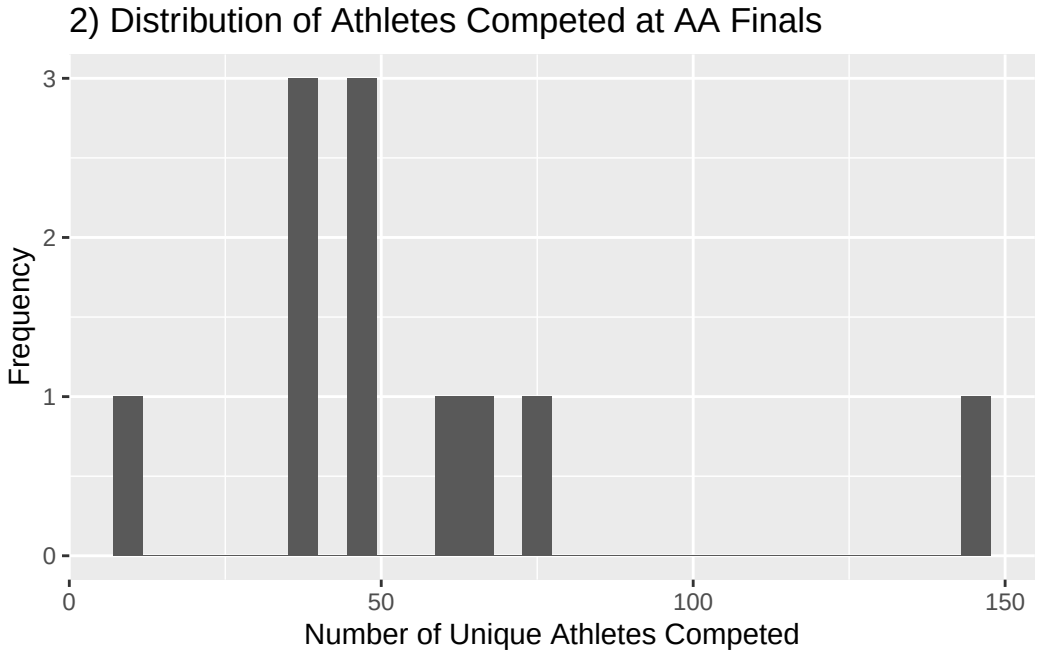
Visualizations





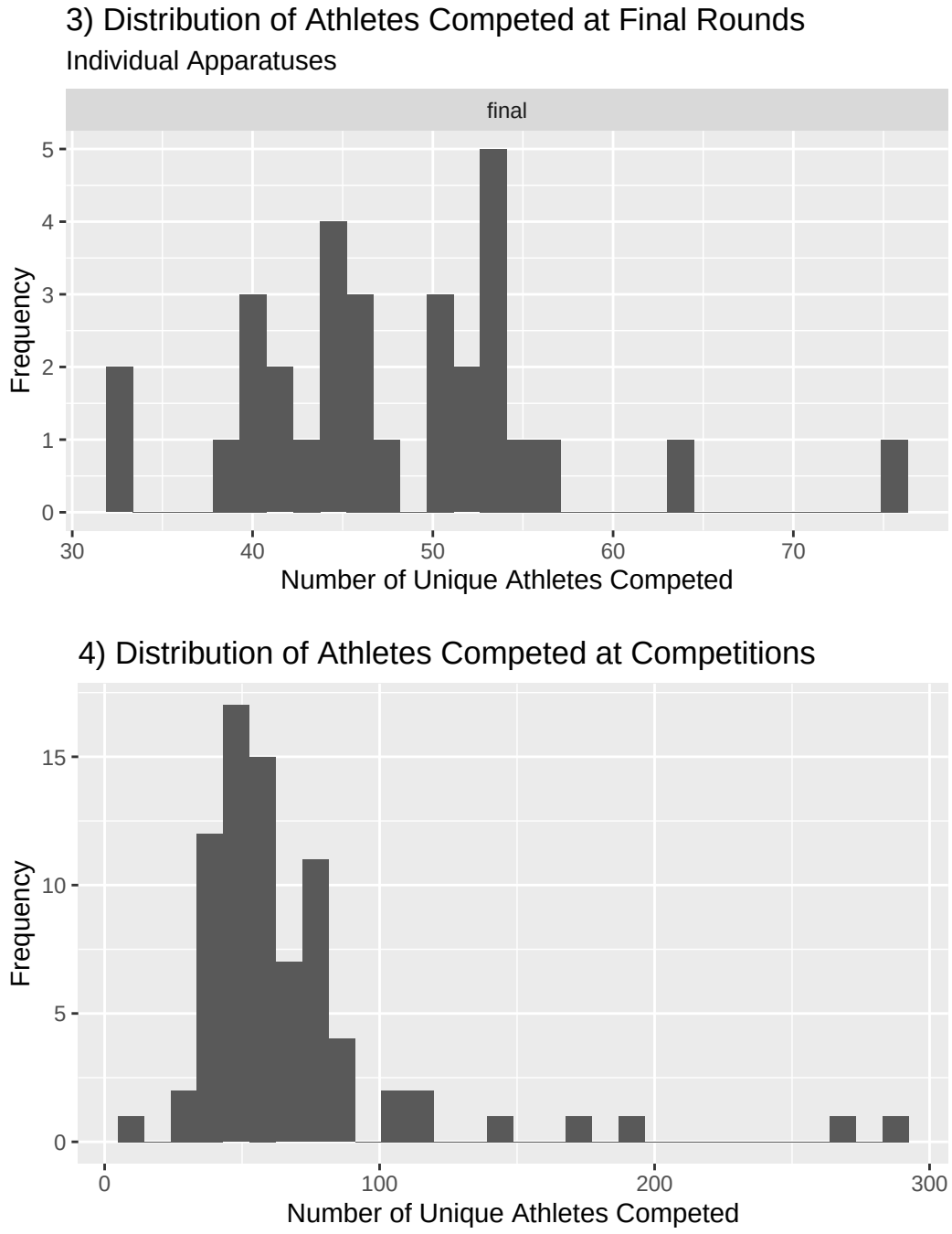
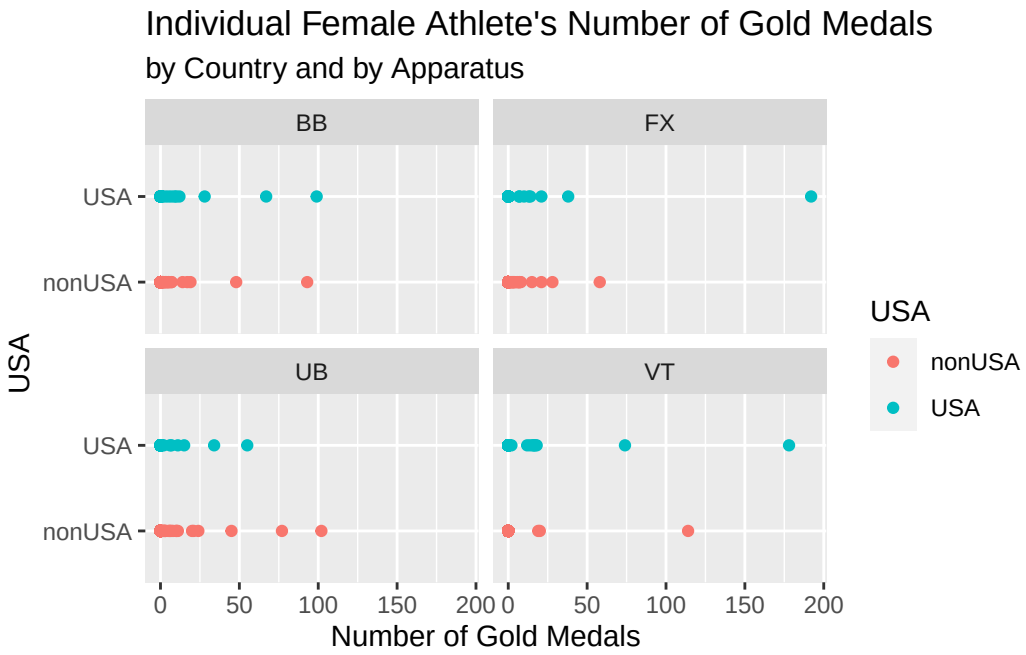

3) Distribution of Athletes Competed at Final Rounds
Individual Apparatuses
final
Frequency
0
1
2
3
4
5
30
40
50
60
70
Number of Unique Athletes Competed
4) Distribution of Athletes Competed at Competitions
Frequency
0
5
10
15
0
100
200
300
Number of Unique Athletes Competed

Image 5)


Individual Female Athlete's Number of Gold Medals
by Country and by Apparatus
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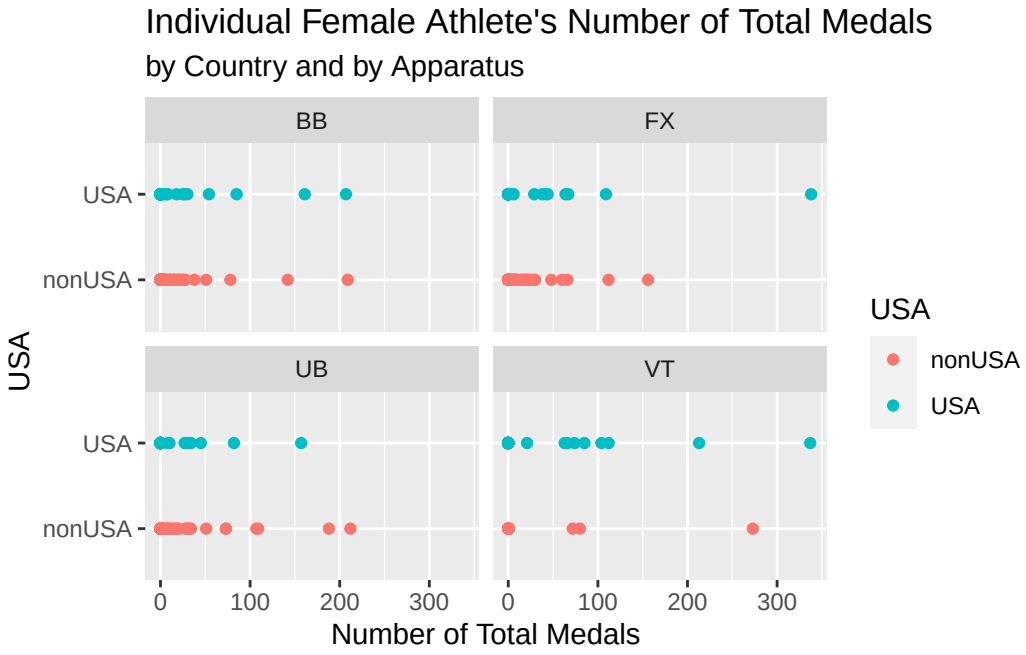
UB
VT
USA
nonUSA
USA
0
50
100
150
200
Number of Gold Medals
USA
nonUSA
USA


Individual Female Athlete's Number of Total Medals
by Country and by Apparatus
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FX
UB
VT
USA
nonUSA
USA
0
100
200
300
Number of Total Medals
USA
nonUSA
USA

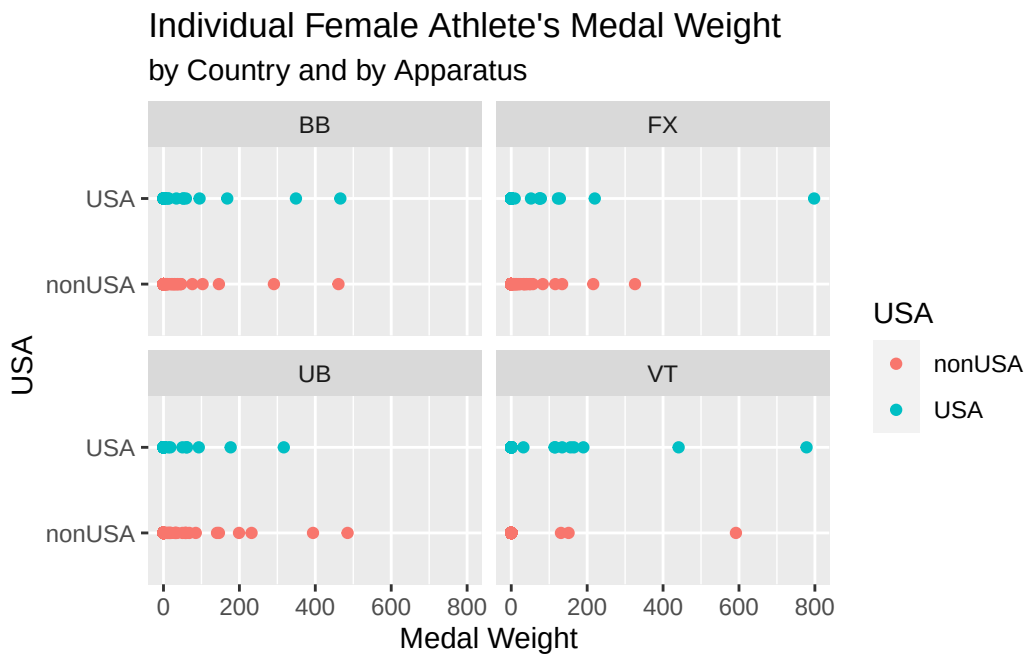
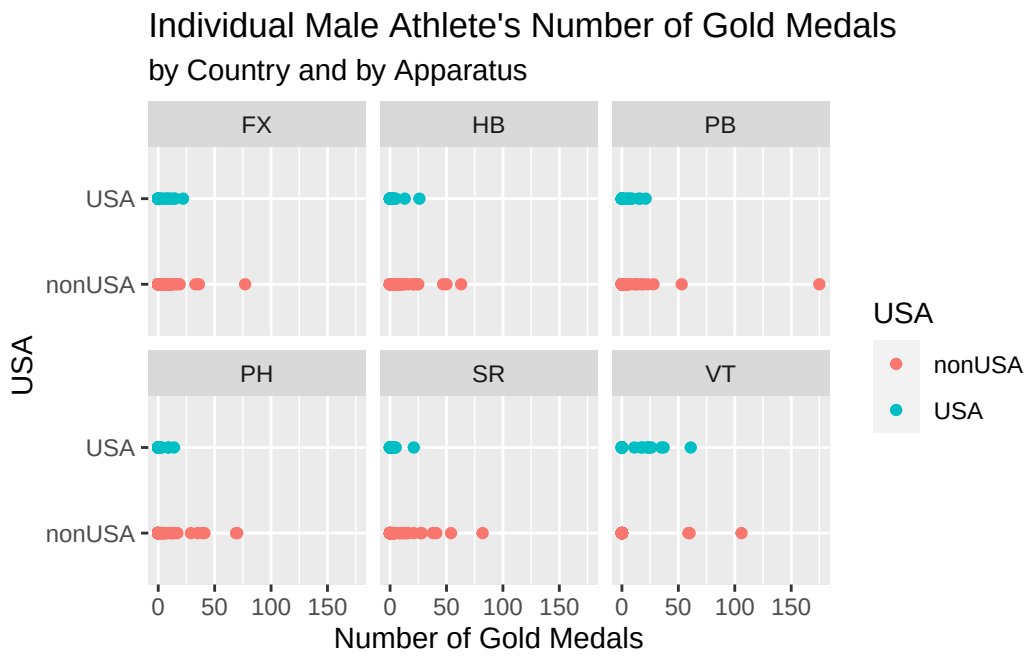

Individual Female Athlete's Medal Weight
by Country and by Apparatus
BB
FX
UB
VT
USA
nonUSA
USA
0
200
400
600
800
Medal Weight
USA
nonUSA
USA

Image 6)


Individual Male Athlete's Number of Gold Medals
by Country and by Apparatus
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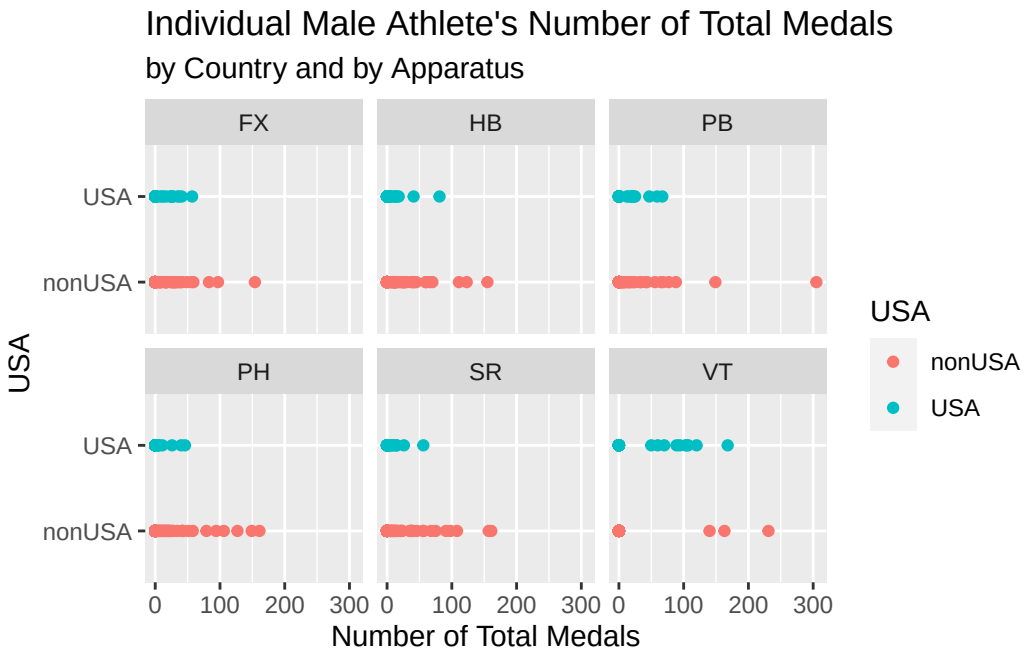
HB
PB
PH
SR
VT
USA
nonUSA
USA
0
50
100
150
Number of Gold Medals
USA
nonUSA
USA


Individual Male Athlete's Number of Total Medals
by Country and by Apparatus
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HB
PB
PH
SR
VT
USA
nonUSA
0
100
200
300
Number of Total Medals
USA
nonUSA

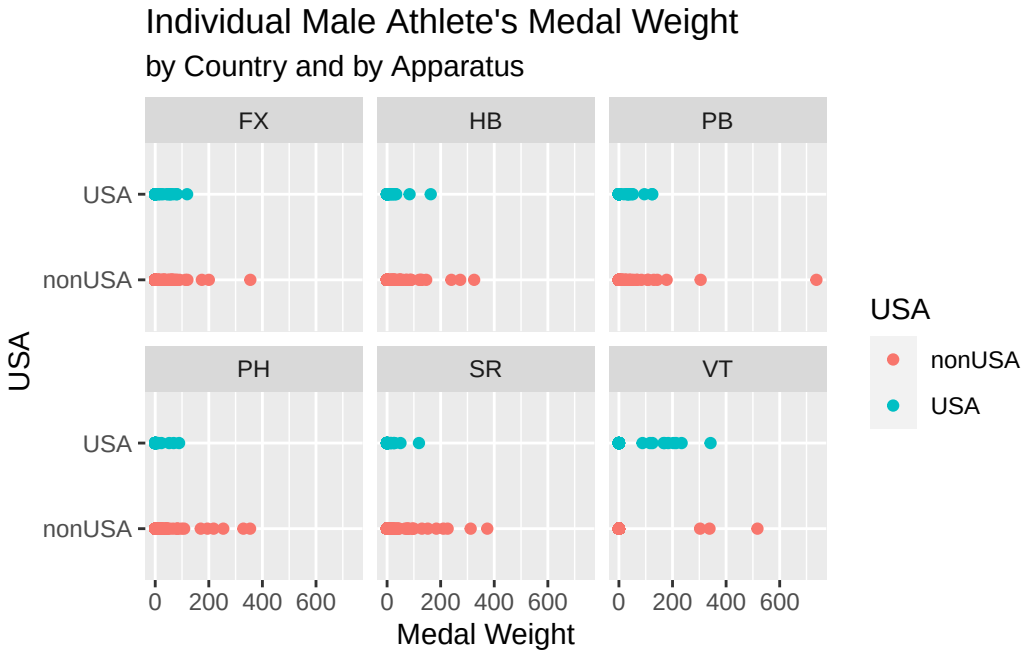
Individual Male Athlete's Medal Weight
by Country and by Apparatus
FX
HB
PB
PH
SR
VT
USA
nonUSA
0
200
400
600
Medal Weight
USA
nonUSA

Image 7)

unique_id	Golds	Silvers	Bronzes	Total_Medals	Country	Medal_Weight	Apparatus	USA
SimBIL_USA	99	61	47	207	USA	466	BB	USA
YaqZHO_CHN	93	66	50	209	CHN	461	BB	nonUSA
KonMCC_USA	67	54	40	161	USA	349	BB	USA
QinZHA_CHN	48	53	41	142	CHN	291	BB	nonUSA
SunLEE_USA	28	27	30	85	USA	168	BB	USA
SimBIL_USA	192	76	70	338	USA	798	FX	USA
RebAND_BRA	58	54	44	156	BRA	326	FX	nonUSA
KalLIN_USA	38	35	36	109	USA	220	FX	USA
JesGAD_GBR	28	48	36	112	GBR	216	FX	nonUSA
FlaSAR_BRA	21	26	19	66	BRA	134	FX	nonUSA
JorCHI_USA	21	22	21	64	USA	128	FX	USA
KayNEM_ALG	102	69	41	212	ALG	485	UB	nonUSA
QiyQIU_CHN	77	52	59	188	CHN	394	UB	nonUSA
ShiJON_USA	55	50	52	157	USA	317	UB	USA
XiaWEI_CHN	45	33	31	109	CHN	232	UB	nonUSA
ZoeMIL_USA	34	27	21	82	USA	177	UB	USA
SimBIL_USA	178	85	74	337	USA	778	VT	USA
RebAND_BRA	114	91	68	273	BRA	592	VT	nonUSA
JadCAR_USA	74	80	59	213	USA	441	VT	USA
OndACH_GBR	20	31	29	80	GBR	151	VT	nonUSA
ShoMIY_JPN	19	21	32	72	JPN	131	VT	nonUSA

unique_id	Golds	Silvers	Bronzes	Total_Medals	Country	Medal_Weight	Apparatus	USA
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JadCAR_USA	14	28	25	67	USA	123	FX	USA
KayNEM_ALG	102	69	41	212	ALG	485	UB	nonUSA
QiyQIU_CHN	77	52	59	188	CHN	394	UB	nonUSA
ShiJON_USA	55	50	52	157	USA	317	UB	USA
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AliD A_ITA	24	44	39	107	ITA	199	UB	nonUSA
SimBIL_USA	178	85	74	337	USA	778	VT	USA
RebAND_BRA	114	91	68	273	BRA	592	VT	nonUSA
JadCAR_USA	74	80	59	213	USA	441	VT	USA
ShiJON_USA	16	46	50	112	USA	190	VT	USA
JorCHI_USA	16	29	59	104	USA	165	VT	USA

unique_id	Golds	Silvers	Bronzes	Total_Medals	Country	Medal_Weight	Apparatus	USA
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KalLIN_USA	38	35	36	109	USA	220	FX	USA
JesGAD_GBR	28	48	36	112	GBR	216	FX	nonUSA
FlaSAR_BRA	21	26	19	66	BRA	134	FX	nonUSA
KayNEM_ALG	102	69	41	212	ALG	485	UB	nonUSA
QiyQIU_CHN	77	52	59	188	CHN	394	UB	nonUSA
ShiJON_USA	55	50	52	157	USA	317	UB	USA
XiaWEI_CHN	45	33	31	109	CHN	232	UB	nonUSA
AliD A_ITA	24	44	39	107	ITA	199	UB	nonUSA
SimBIL_USA	178	85	74	337	USA	778	VT	USA
RebAND_BRA	114	91	68	273	BRA	592	VT	nonUSA
JadCAR_USA	74	80	59	213	USA	441	VT	USA
ShiJON_USA	16	46	50	112	USA	190	VT	USA
JorCHI_USA	16	29	59	104	USA	165	VT	USA

USA	sumGolds	sumTot	sumWeighted
nonUSA	978	3168	6217
USA	1022	2832	5783

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.

Image 8)

unique_id	Golds	Silvers	Bronzes	Total_Medals	Country	Medal_Weight	Apparatus	USA
CarYUL_PHI	77	47	30	154	PHI	355	FX	nonUSA
ArtDOL_ISR	36	31	30	97	ISR	200	FX	nonUSA
RyoDOI_JPN	33	25	25	83	JPN	174	FX	nonUSA
PauJUD_USA	22	18	17	57	USA	119	FX	USA
DaiHAS_JPN	19	19	18	56	JPN	113	FX	nonUSA
DaiHAS_JPN	63	44	48	155	JPN	325	HB	nonUSA
ConSHI_CHN	50	29	32	111	CHN	240	HB	nonUSA
BohZHA_CHN	47	56	20	123	CHN	273	HB	nonUSA
BroMAL_USA	26	30	25	81	USA	163	HB	USA
WeiSUN_CHN	25	30	11	66	CHN	146	HB	nonUSA
JinZOU_CHN	175	82	48	305	CHN	737	PB	nonUSA
LukDAU_GER	53	50	46	149	GER	305	PB	nonUSA
BohZHA_CHN	28	34	26	88	CHN	178	PB	nonUSA
CarYUL_PHI	23	20	34	77	PHI	143	PB	nonUSA
CurPHI_USA	21	23	15	59	USA	124	PB	USA
MaxWHI_GBR	70	53	38	161	GBR	354	PH	nonUSA
Mc CLE_IRL	69	42	38	149	IRL	329	PH	nonUSA
ChiLEE_TPE	41	45	41	127	TPE	254	PH	nonUSA
NarKUR_KAZ	39	34	33	106	KAZ	218	PH	nonUSA
RhyMCC_IRL	35	31	28	94	IRL	195	PH	nonUSA
YanLIU_CHN	82	49	30	161	CHN	374	SR	nonUSA
XinLAN_CHN	54	47	56	157	CHN	312	SR	nonUSA
JinZOU_CHN	41	36	31	108	CHN	226	SR	nonUSA
ElePET_GRE	38	36	24	98	GRE	210	SR	nonUSA
AdeASI_TUR	28	37	26	91	TUR	184	SR	nonUSA
JakJAR_GBR	106	74	51	231	GBR	517	VT	nonUSA
AshHON_USA	61	52	55	168	USA	342	VT	USA
DaiHAS_JPN	60	55	48	163	JPN	338	VT	nonUSA
BohZHA_CHN	59	45	36	140	CHN	303	VT	nonUSA
KhoYOU_USA	37	32	38	107	USA	213	VT	USA

unique_id	Golds	Silvers	Bronzes	Total_Medals	Country	Medal_Weight	Apparatus	USA
CarYUL_PHI	77	47	30	154	PHI	355	FX	nonUSA
ArtDOL_ISR	36	31	30	97	ISR	200	FX	nonUSA
RyoDOI_JPN	33	25	25	83	JPN	174	FX	nonUSA
BohZHA_CHN	17	27	15	59	CHN	120	FX	nonUSA
PauJUD_USA	22	18	17	57	USA	119	FX	USA
DaiHAS_JPN	63	44	48	155	JPN	325	HB	nonUSA
BohZHA_CHN	47	56	20	123	CHN	273	HB	nonUSA
ConSHI_CHN	50	29	32	111	CHN	240	HB	nonUSA
BroMAL_USA	26	30	25	81	USA	163	HB	USA
MilKAR_KAZ	21	18	31	70	KAZ	130	HB	nonUSA
JinZOU_CHN	175	82	48	305	CHN	737	PB	nonUSA
LukDAU_GER	53	50	46	149	GER	305	PB	nonUSA
BohZHA_CHN	28	34	26	88	CHN	178	PB	nonUSA
CarYUL_PHI	23	20	34	77	PHI	143	PB	nonUSA
IllKOV_UKR	17	28	23	68	UKR	130	PB	nonUSA
MaxWHI_GBR	70	53	38	161	GBR	354	PH	nonUSA
Mc CLE_IRL	69	42	38	149	IRL	329	PH	nonUSA
ChiLEE_TPE	41	45	41	127	TPE	254	PH	nonUSA
NarKUR_KAZ	39	34	33	106	KAZ	218	PH	nonUSA
RhyMCC_IRL	35	31	28	94	IRL	195	PH	nonUSA
YanLIU_CHN	82	49	30	161	CHN	374	SR	nonUSA
XinLAN_CHN	54	47	56	157	CHN	312	SR	nonUSA
JinZOU_CHN	41	36	31	108	CHN	226	SR	nonUSA
ElePET_GRE	38	36	24	98	GRE	210	SR	nonUSA
AdeASI_TUR	28	37	26	91	TUR	184	SR	nonUSA
JakJAR_GBR	106	74	51	231	GBR	517	VT	nonUSA
AshHON_USA	61	52	55	168	USA	342	VT	USA
DaiHAS_JPN	60	55	48	163	JPN	338	VT	nonUSA
BohZHA_CHN	59	45	36	140	CHN	303	VT	nonUSA
DalHAL_USA	35	44	41	120	USA	234	VT	USA

unique_id	Golds	Silvers	Bronzes	Total_Medals	Country	Medal_Weight	Apparatus	USA
CarYUL_PHI	77	47	30	154	PHI	355	FX	nonUSA
ArtDOL_ISR	36	31	30	97	ISR	200	FX	nonUSA
RyoDOI_JPN	33	25	25	83	JPN	174	FX	nonUSA
BohZHA_CHN	17	27	15	59	CHN	120	FX	nonUSA
PauJUD_USA	22	18	17	57	USA	119	FX	USA
DaiHAS_JPN	63	44	48	155	JPN	325	HB	nonUSA
BohZHA_CHN	47	56	20	123	CHN	273	HB	nonUSA
ConSHI_CHN	50	29	32	111	CHN	240	HB	nonUSA
BroMAL_USA	26	30	25	81	USA	163	HB	USA
WeiSUN_CHN	25	30	11	66	CHN	146	HB	nonUSA
JinZOU_CHN	175	82	48	305	CHN	737	PB	nonUSA
LukDAU_GER	53	50	46	149	GER	305	PB	nonUSA
BohZHA_CHN	28	34	26	88	CHN	178	PB	nonUSA
CarYUL_PHI	23	20	34	77	PHI	143	PB	nonUSA
IllKOV_UKR	17	28	23	68	UKR	130	PB	nonUSA
MaxWHI_GBR	70	53	38	161	GBR	354	PH	nonUSA
Mc CLE_IRL	69	42	38	149	IRL	329	PH	nonUSA
ChiLEE_TPE	41	45	41	127	TPE	254	PH	nonUSA
NarKUR_KAZ	39	34	33	106	KAZ	218	PH	nonUSA
RhyMCC_IRL	35	31	28	94	IRL	195	PH	nonUSA
YanLIU_CHN	82	49	30	161	CHN	374	SR	nonUSA
XinLAN_CHN	54	47	56	157	CHN	312	SR	nonUSA
JinZOU_CHN	41	36	31	108	CHN	226	SR	nonUSA
ElePET_GRE	38	36	24	98	GRE	210	SR	nonUSA
AdeASI_TUR	28	37	26	91	TUR	184	SR	nonUSA
JakJAR_GBR	106	74	51	231	GBR	517	VT	nonUSA
AshHON_USA	61	52	55	168	USA	342	VT	USA
DaiHAS_JPN	60	55	48	163	JPN	338	VT	nonUSA
BohZHA_CHN	59	45	36	140	CHN	303	VT	nonUSA
DalHAL_USA	35	44	41	120	USA	234	VT	USA

USA	sumGolds	sumTot	sumWeighted
nonUSA	2375	6843	13842
USA	625	2157	4158

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.

Image 9)

unique_id	Golds	Country	Apparatus	USA
SimBIL_USA	99	USA	BB	USA
YaqZHO_CHN	93	CHN	BB	nonUSA
KonMCC_USA	67	USA	BB	USA
QinZHA_CHN	48	CHN	BB	nonUSA
SunLEE_USA	28	USA	BB	USA
YusOU___CHN	19	CHN	BB	nonUSA
HuaLUO_CHN	17	CHN	BB	nonUSA
UraASH_JPN	14	JPN	BB	nonUSA
SkyBLA_USA	12	USA	BB	USA
ShiJON_USA	10	USA	BB	USA
SimBIL_USA	192	USA	FX	USA
RebAND_BRA	58	BRA	FX	nonUSA
KalLIN_USA	38	USA	FX	USA
JesGAD_GBR	28	GBR	FX	nonUSA
FlaSAR_BRA	21	BRA	FX	nonUSA
JorCHI_USA	21	USA	FX	USA
MarMAG_ITA	15	ITA	FX	nonUSA
JadCAR_USA	14	USA	FX	USA
KonMCC_USA	13	USA	FX	USA
ShiJON_USA	10	USA	FX	USA
KayNEM_ALG	102	ALG	UB	nonUSA
QiyQIU_CHN	77	CHN	UB	nonUSA
ShiJON_USA	55	USA	UB	USA
XiaWEI_CHN	45	CHN	UB	nonUSA
ZoeMIL_USA	34	USA	UB	USA
AliD A_ITA	24	ITA	UB	nonUSA
RebAND_BRA	21	BRA	UB	nonUSA
XijTAN_CHN	20	CHN	UB	nonUSA
SimBIL_USA	15	USA	UB	USA
YunLEE_KOR	11	KOR	UB	nonUSA
SkyBLA_USA	11	USA	UB	USA
SimBIL_USA	178	USA	VT	USA
RebAND_BRA	114	BRA	VT	nonUSA
JadCAR_USA	74	USA	VT	USA
OndACH_GBR	20	GBR	VT	nonUSA
ShoMIY_JPN	19	JPN	VT	nonUSA
KonMCC_USA	18	USA	VT	USA
SkyBLA_USA	17	USA	VT	USA
ShiJON_USA	16	USA	VT	USA
JorCHI_USA	16	USA	VT	USA
TiaSUM_USA	14	USA	VT	USA

Image 10)

```
Warning: Removed 4 rows containing missing values (`geom_point()`).
```

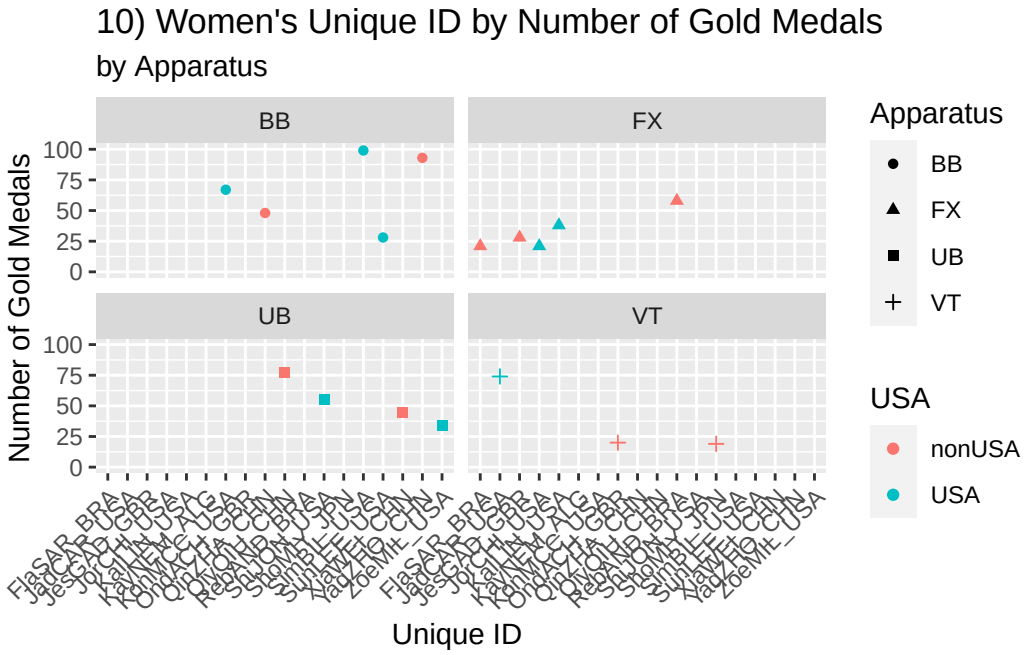
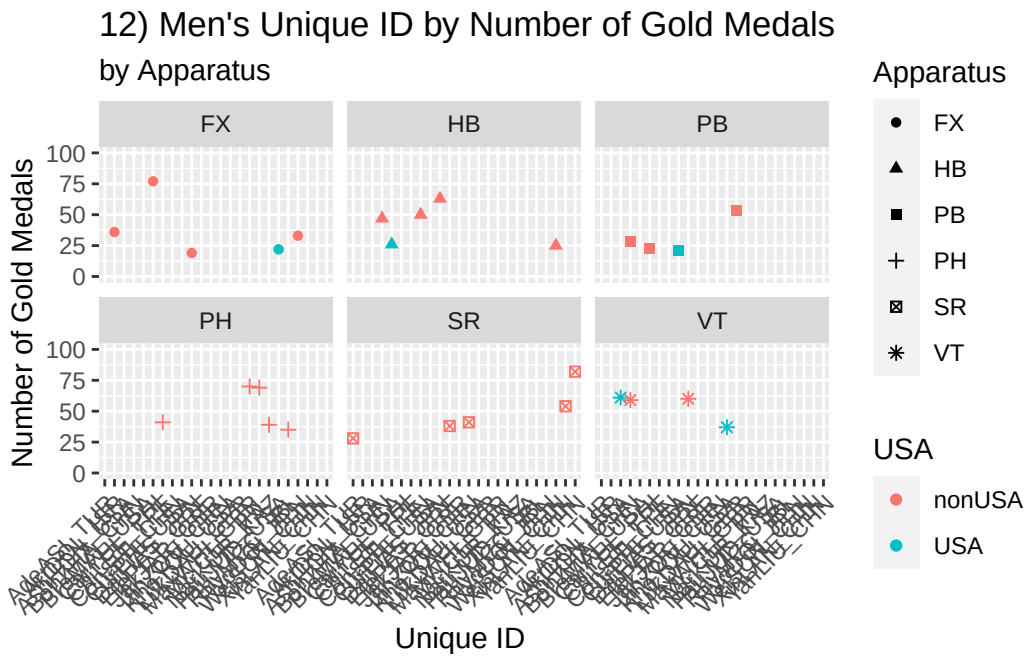

10) Women's Unique ID by Number of Gold Medals
by Apparatus
BB
FX
UB
VT
Number of Gold Medals
100
75
50
25
0
Unique ID
Apparatus
BB
FX
UB
VT
USA
nonUSA
USA

Image 11)

unique_id	Golds	Country	Apparatus	USA
CarYUL_PHI	77	PHI	FX	nonUSA
ArtDOL_ISR	36	ISR	FX	nonUSA
RyoDOI_JPN	33	JPN	FX	nonUSA
PauJUD_USA	22	USA	FX	USA
DaiHAS_JPN	19	JPN	FX	nonUSA
BohZHA_CHN	17	CHN	FX	nonUSA
HarHEP_GBR	15	GBR	FX	nonUSA
DonWHI_USA	15	USA	FX	USA
YulMOL_USA	14	USA	FX	USA
KazMIN_JPN	12	JPN	FX	nonUSA
NicBAR_ITA	12	ITA	FX	nonUSA
KakTAN_JPN	12	JPN	FX	nonUSA
MilKAR_KAZ	12	KAZ	FX	nonUSA
DmiPAT_KAZ	12	KAZ	FX	nonUSA
ColWAL_USA	12	USA	FX	USA
DaiHAS_JPN	63	JPN	HB	nonUSA
ConSHI_CHN	50	CHN	HB	nonUSA
BohZHA_CHN	47	CHN	HB	nonUSA
BroMAL_USA	26	USA	HB	USA
WeiSUN_CHN	25	CHN	HB	nonUSA
ShoKAW_JPN	24	JPN	HB	nonUSA
MilKAR_KAZ	21	KAZ	HB	nonUSA
WeiSU___CHN	20	CHN	HB	nonUSA
ChaLIN_CHN	16	CHN	HB	nonUSA
FreRIC_USA	13	USA	HB	USA
YuyKAM_JPN	13	JPN	HB	nonUSA
JinZOU_CHN	175	CHN	PB	nonUSA
LukDAU_GER	53	GER	PB	nonUSA
BohZHA_CHN	28	CHN	PB	nonUSA
CarYUL_PHI	23	PHI	PB	nonUSA
CurPHI_USA	21	USA	PB	USA
KaiSUG_JPN	19	JPN	PB	nonUSA
IllKOV_UKR	17	UKR	PB	nonUSA
ColWAL_USA	16	USA	PB	USA
BlaSUN_USA	15	USA	PB	USA
JoeFRA_GBR	13	GBR	PB	nonUSA
FerARI_TUR	13	TUR	PB	nonUSA
MaxWHI_GBR	70	GBR	PH	nonUSA
Mc CLE_IRL	69	IRL	PH	nonUSA
ChiLEE_TPE	41	TPE	PH	nonUSA
NarKUR_KAZ	39	KAZ	PH	nonUSA
RhyMCC_IRL	35	IRL	PH	nonUSA
AhmSOU_JOR	29	JOR	PH	nonUSA
AhmABU_JOR	17	JOR	PH	nonUSA
RhyMC _IRL	16	IRL	PH	nonUSA
SteNED_USA	14	USA	PH	USA
Yu-SHI_TPE	14	TPE	PH	nonUSA
YanLIU_CHN	82	CHN	SR	nonUSA
XinLAN_CHN	54	CHN	SR	nonUSA
JinZOU_CHN	41	CHN	SR	nonUSA
ElePET_GRE	38	GRE	SR	nonUSA
AdeASI_TUR	28	TUR	SR	nonUSA
HaoYOU_CHN	27	CHN	SR	nonUSA

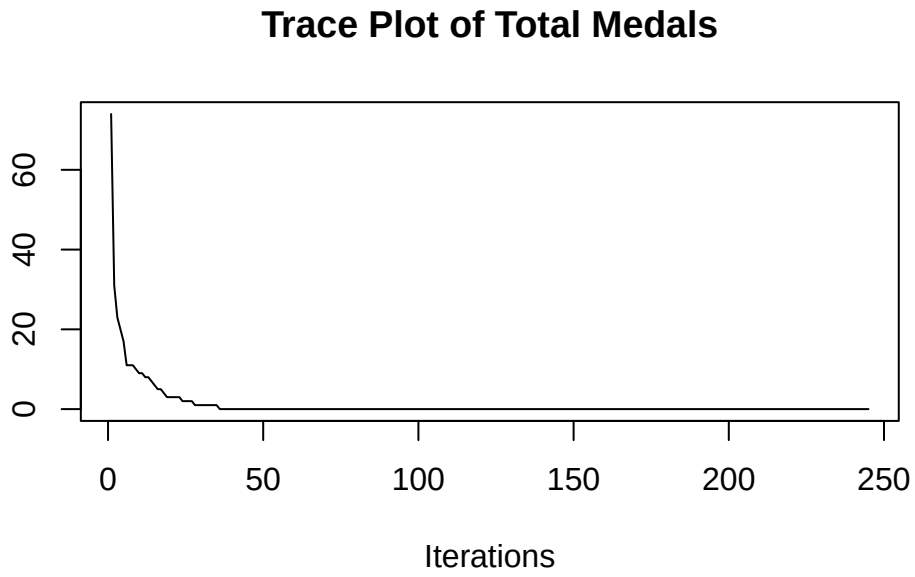
Image 12)

```
Warning: Removed 2 rows containing missing values (`geom_point()`).
```

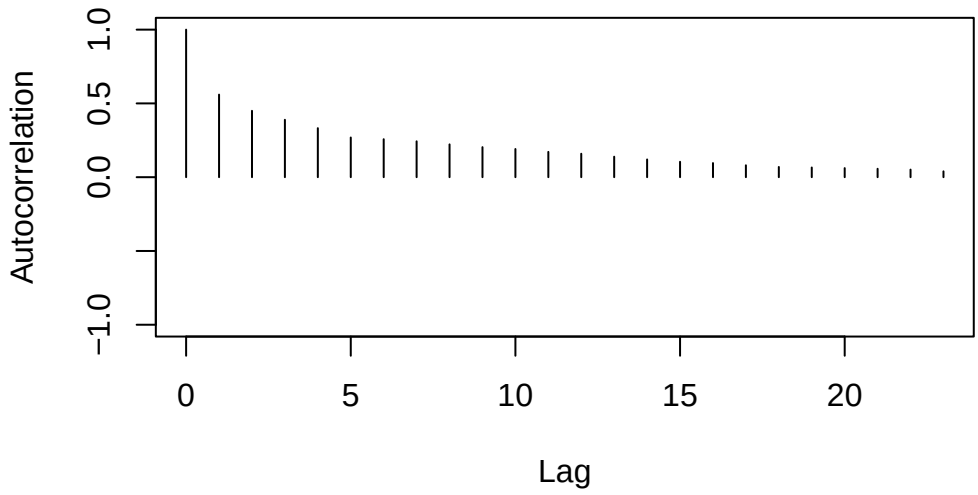


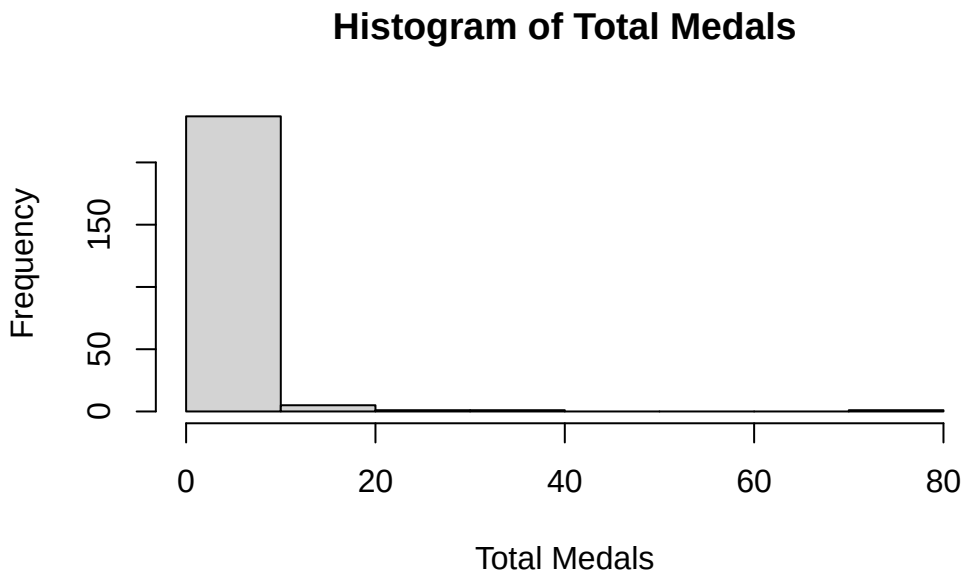
Note: The excessive overlap in unique ids displays that there is not much overlap in the top 5 most gold medal decorated athletes on the men's team and therefore the lack of well-rounded gymnasts.

Diagnostics



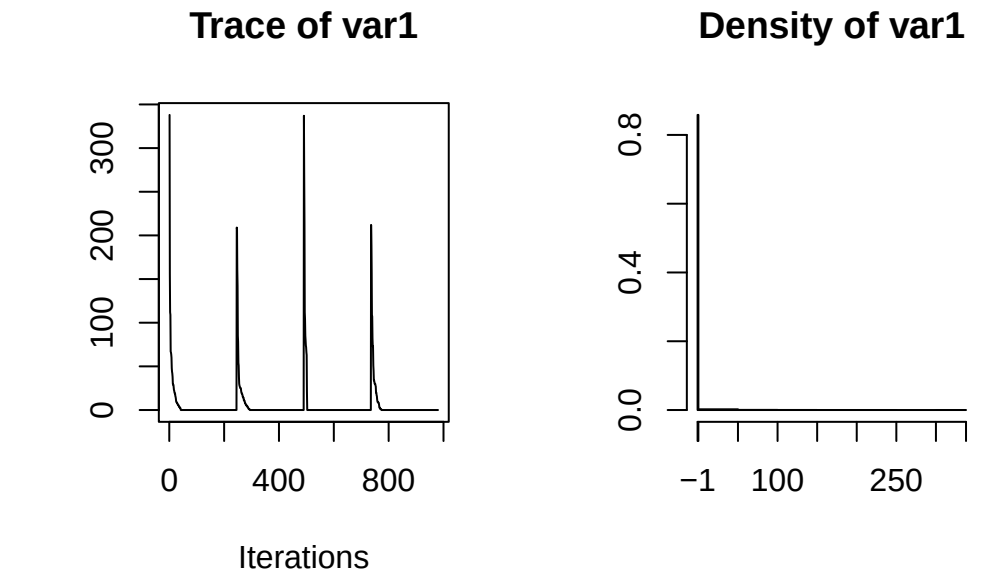

```
    var1
36.19828
```

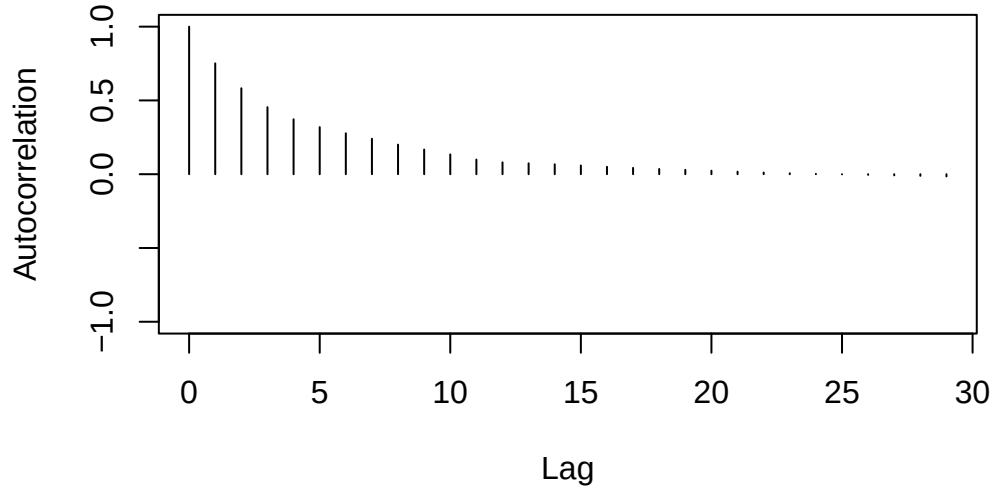





```
Iterations = 1:980
Thinning interval = 1
Number of chains = 1
Sample size per chain = 980

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

          Mean             SD       Naive SE Time-series SE
         6.122         28.016          0.895          2.376

2. Quantiles for each variable:
```

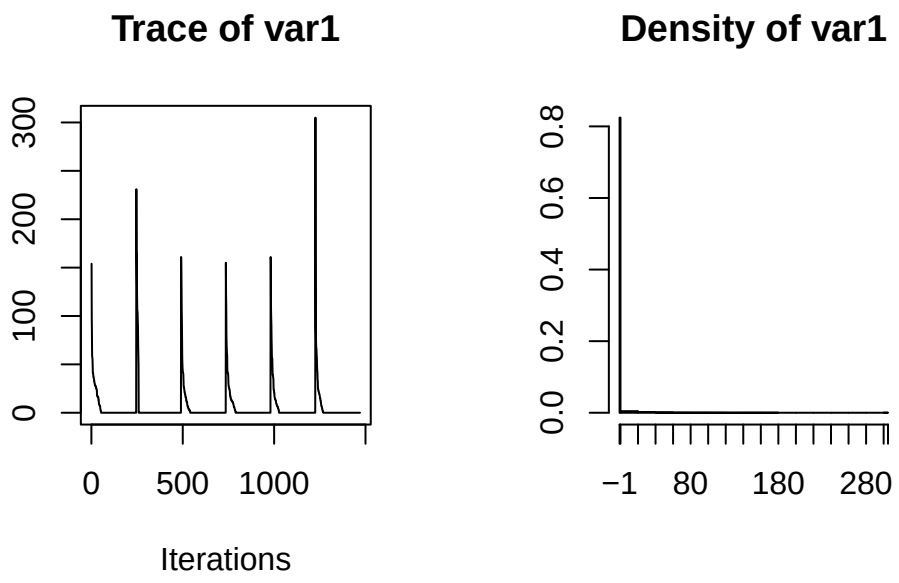
```
 2.5%   25%   50%   75% 97.5%
    0     0     0     0    73

     var1
0.1041879

    var1
138.9839
```

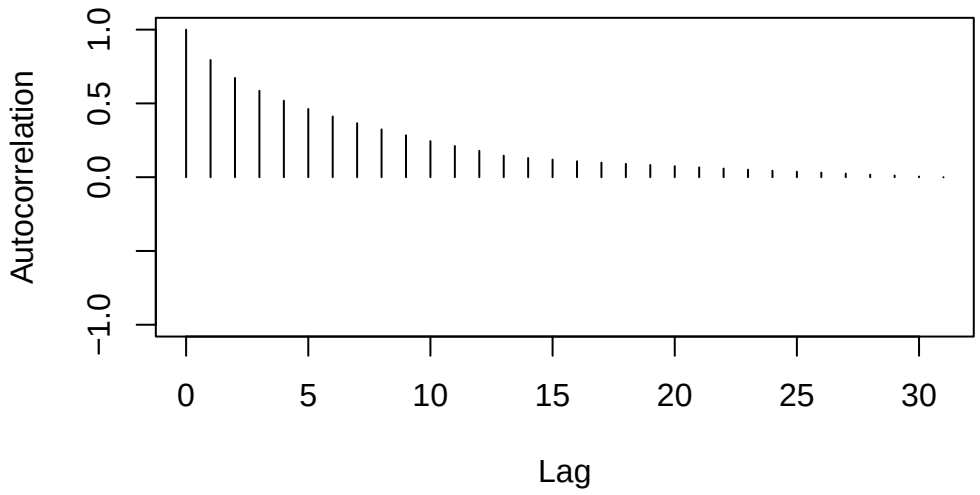





```
Iterations = 1:1470
Thinning interval = 1
Number of chains = 1
```

```
Sample size per chain = 1470

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

          Mean             SD       Naive SE Time-series SE
         6.122         22.009          0.574          2.102

2. Quantiles for each variable:

 2.5%   25%   50%   75% 97.5%
 0.00  0.00  0.00  0.00 67.27


     var1
0.1238938


    var1
109.6312
```




Autocorrelation
1.0
0.5
0.0
−1.0
0
5
10
15
20
25
30
Lag