

UOP Water Polo Data Analytics

(For both the men's and women's training and the testing data, I included the *other* value for the Defense column since all of the *penalty* values in the Type column were in the same rows with the Defense value of *other* for the women's data)

1. Miscellaneous Statistical Data

Number of Shots

Men	Women
5173	1605

Shots By Hand

	Right	Left
Men	77.267%	22.733%
Women	83.364%	16.636%

Defensive Scenario

	Uncontested	Pressured	Field Blocker	Contested	Other
Men	7.946%	18.030%	47.678%	26.345%	0.503%
Women	3.676%	16.885%	51.402%	24.299%	3.738%

Offensive Scenario

	Even	Counter	Power Play	Penalty
Men	65.011%	11.193%	22.018%	1.778%
Women	65.794%	5.794%	24.860%	3.551%

Accuracy for Logistic Model Fit

	Accuracy	NIR	P-value	Training Size
Men	72.47%	66.54%	< 0.001	70%
Women	69.73%	63.18%	< 0.001	60%

2. Comparison of Features and Their Statistical Data

Men's Features and Their Statistical Data in Logistical Model

Variable	Coef.	SE	Z	p-value
(Intercept)	0.80934	0.17558	4.610	<0.001
distance	-0.32808	0.02964	-11.069	<0.001
angle	-1.02783	0.13772	-7.463	<0.001
side="right"	-0.03806	0.06986	-0.545	0.58591
Hand="left"	0.21699	0.08263	2.626	0.00864
type="backhand"	-0.01103	0.16236	-0.068	0.94582
type="lob"	-0.04669	0.16285	-0.287	0.77432
type="skip"	0.78982	0.07127	11.083	<0.001
defense="contested"	-0.31761	0.10064	-3.156	0.00160
defense="uncontested"	0.89110	0.14359	6.206	<0.001
defense="field blocker"	-0.15307	0.09961	-1.537	0.12437
defense="other"	1.00398	0.59201	1.696	0.08991
offense="counter"	0.54075	0.10747	5.032	<0.001
offense="power play"	0.66648	0.07895	8.441	<0.001
offense="penalty shot"	1.08099	0.33155	3.260	0.00111

Men's features, estimated coefficients (Coef.), standard errors of estimates (SE), test statistics (Z), and p-values for nonzero coefficients (p-value) from goal-scoring logistic model

Women's Features and Their Statistical Data in Logistical Model

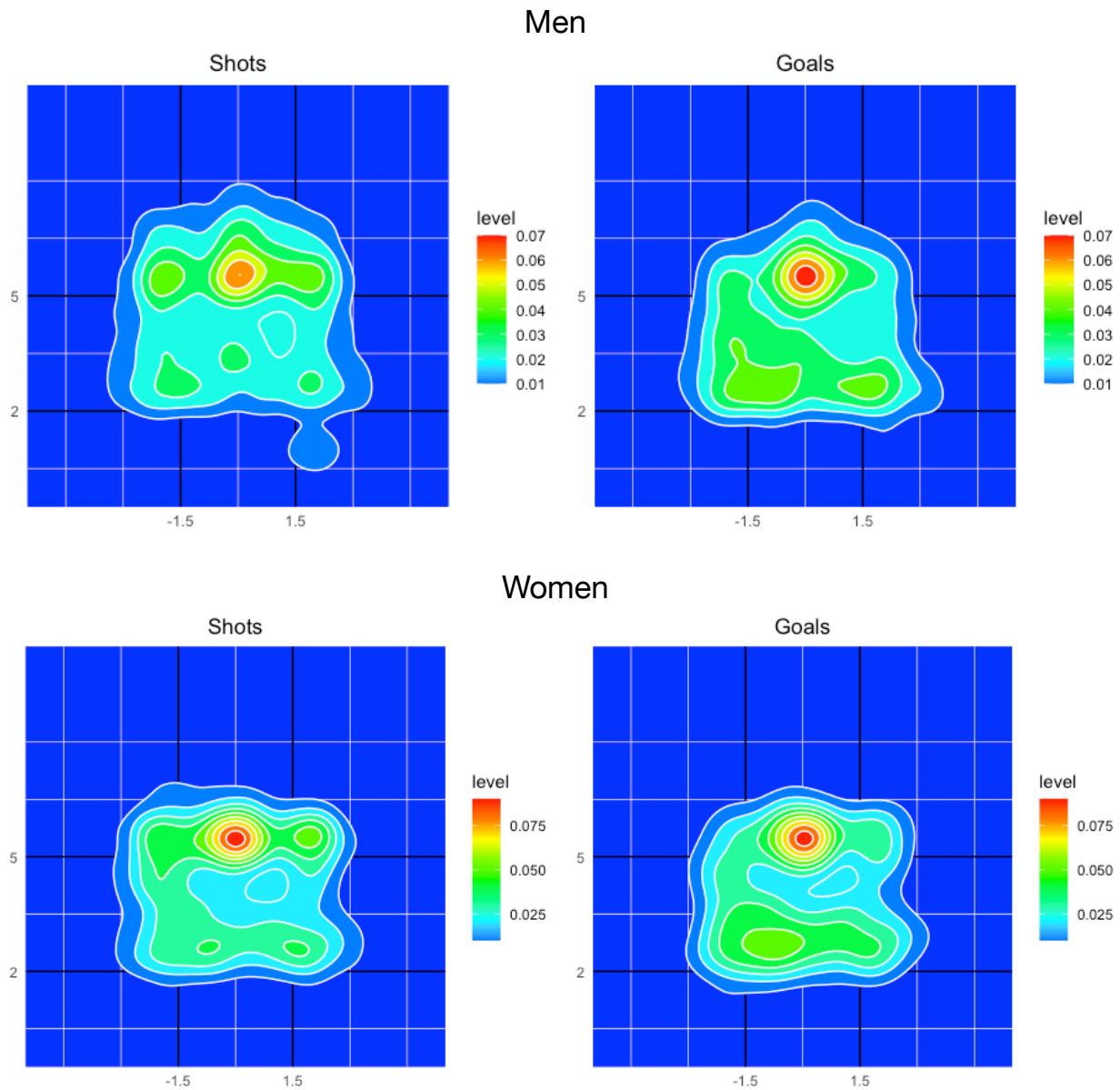
Variable	Coef.	SE	Z	p-value
(Intercept)	1.11415	0.38040	2.929	0.00340
distance	-0.38529	0.05429	-7.097	<0.001
angle	-1.07202	0.25486	-4.206	<0.001
side="right"	-0.09981	0.11753	-0.849	0.39573
Hand="left"	0.06725	0.16141	0.417	0.67694
type="backhand"	0.57236	0.32753	1.748	0.08054
type="lob"	0.27429	0.28985	0.946	0.34397
type="skip"	0.68684	0.31787	2.161	0.03072
defense="pressured"	-0.48417	0.18540	-2.612	0.00901
defense="uncontested"	0.93343	0.33032	2.826	0.00472
defense="field blocker"	-0.01401	0.16834	-0.083	0.93369
defense="other"	0.10409	1.24382	0.084	0.93331
offense="counter"	0.41020	0.24408	1.681	0.09284
offense="power play"	0.56198	0.13508	4.160	<0.001
offense="penalty shot"	1.31355	1.26746	1.036	0.30003

Women's features, estimated coefficients (Coef.), standard errors of estimates (SE), test statistics (Z), and p-values for nonzero coefficients (p-value) from goal-scoring logistic model

Results

The results show that for both men and women, distance, angle, shot type, hand, defender position, and offensive scenario all significantly affect goal-scoring probabilities in men's collegiate water polo while scoring odds are roughly the same on the left and right sides of the pool. For men, *Skip* and *Distance* appeared to be the two of the most significant features followed by *power play*, *angle*, *uncontested*, and *counter*. However, for women, *Distance* was the most significant feature followed by *angle*, *power play*, *uncontested*, *contested*, and *skip*. Furthermore, for men, left-handers are predicted to score at higher rates than right-handers after adjusting for other shot factors, whereas, for women, there is a minimal difference in scoring rates between hands. The odds of scoring a goal for both men and women tend to be higher for left-handed shots, skip shots, or any offensive scenario other than even play.

3. Comparison of Overall Shot/Goal Density Plots

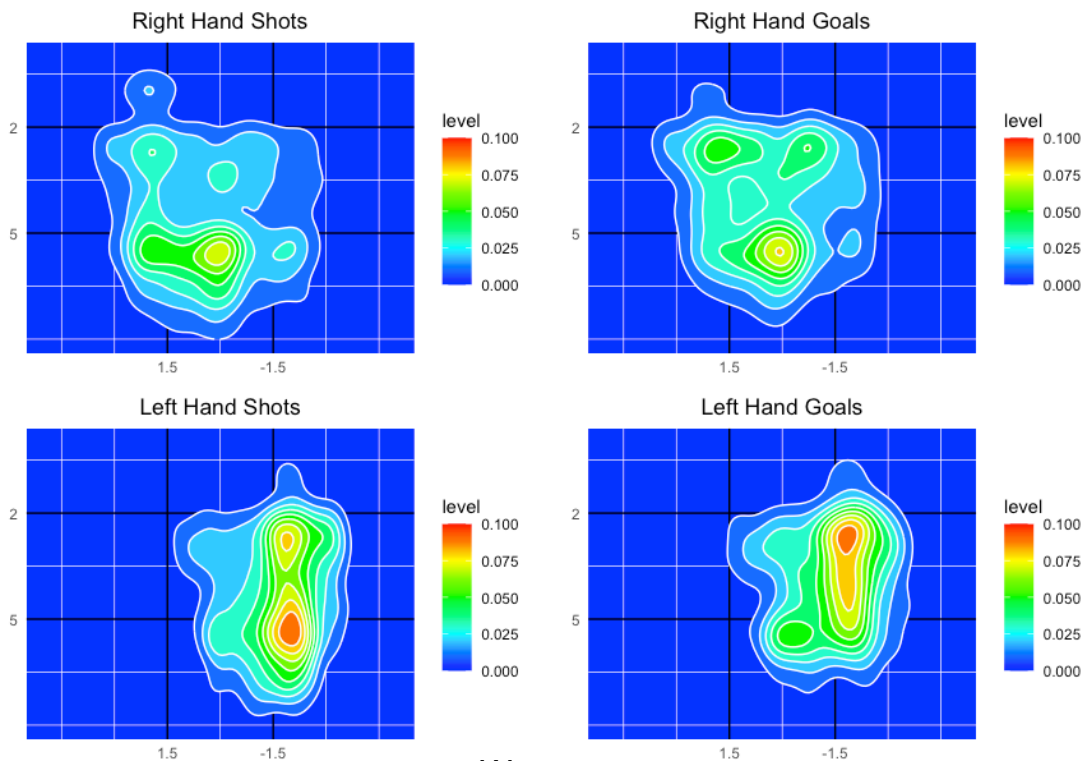


Results

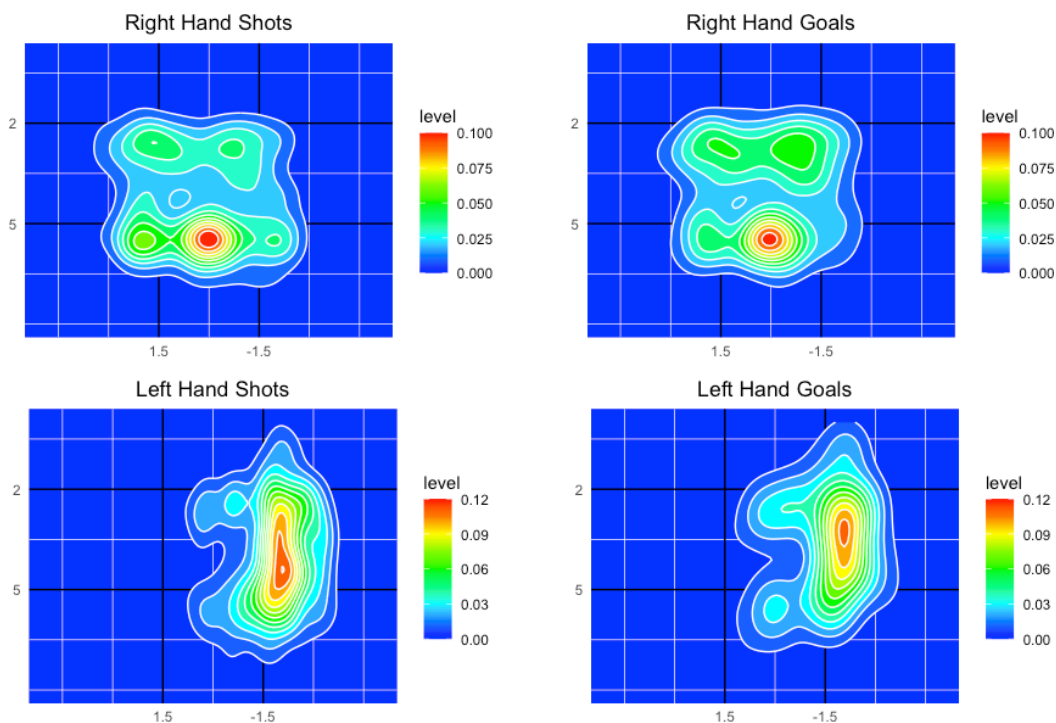
According to the density plot comparisons, men teams mainly shoot around the 5-meter line whereas women teams, though most of their shots are also on the 5-meter line, are more distributed in their shots down near the 3-meter to 2-meter lines. Furthermore, men tend to make goals, if not at the center right ad the 5-meter line, near the left side of the field. Women follow a similar pattern, however their tendency to score on the left side of the field is less noticeable.

4. Comparison of men's and women's right/left handed shot/goal density plots

Men



Women



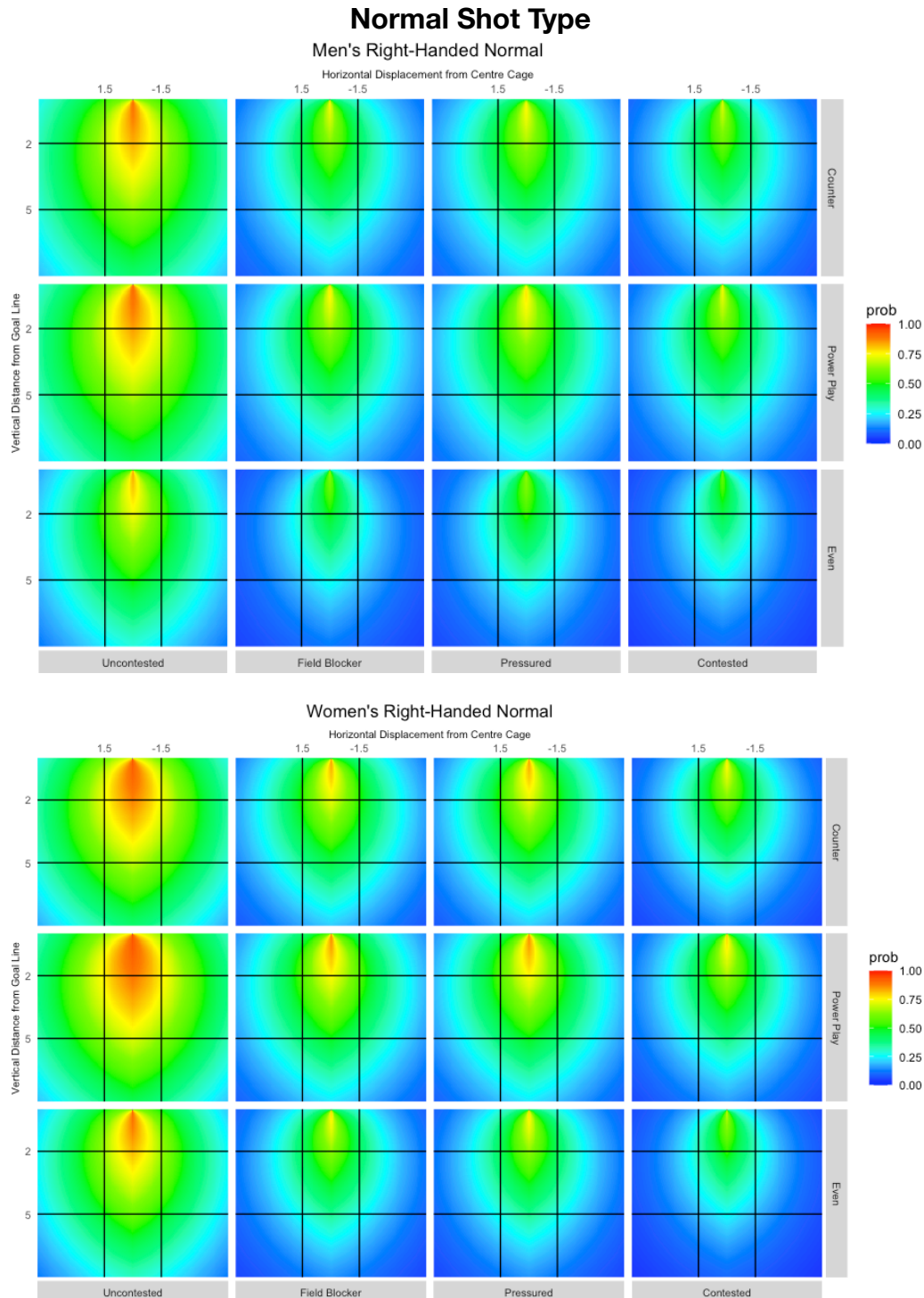
Density plots of men's and women's right/left handed shots and goals

Results

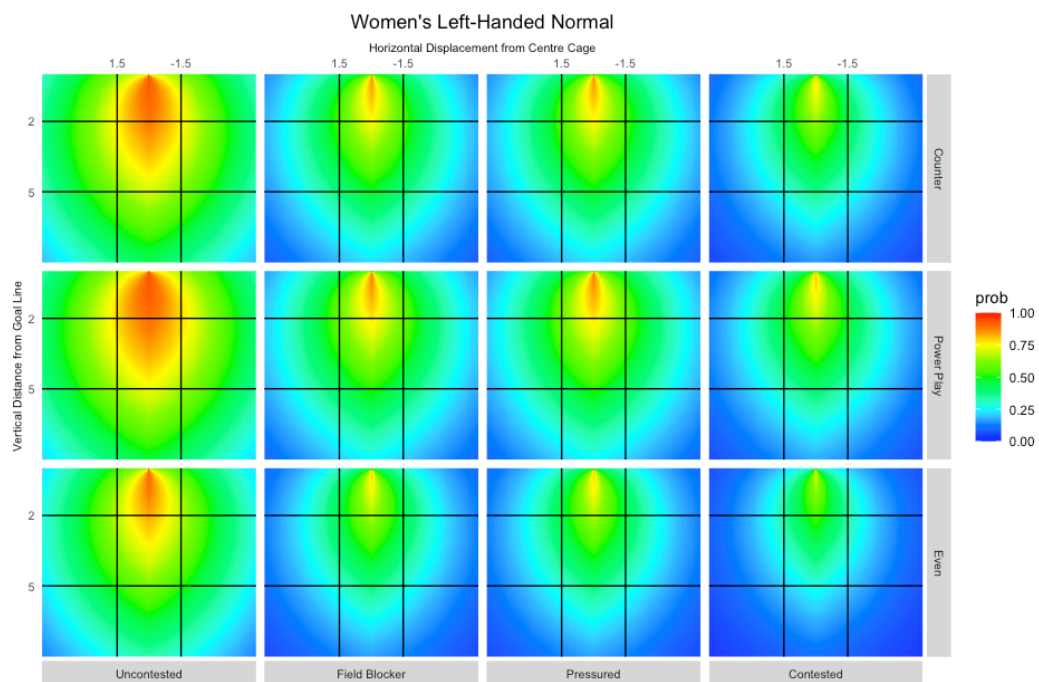
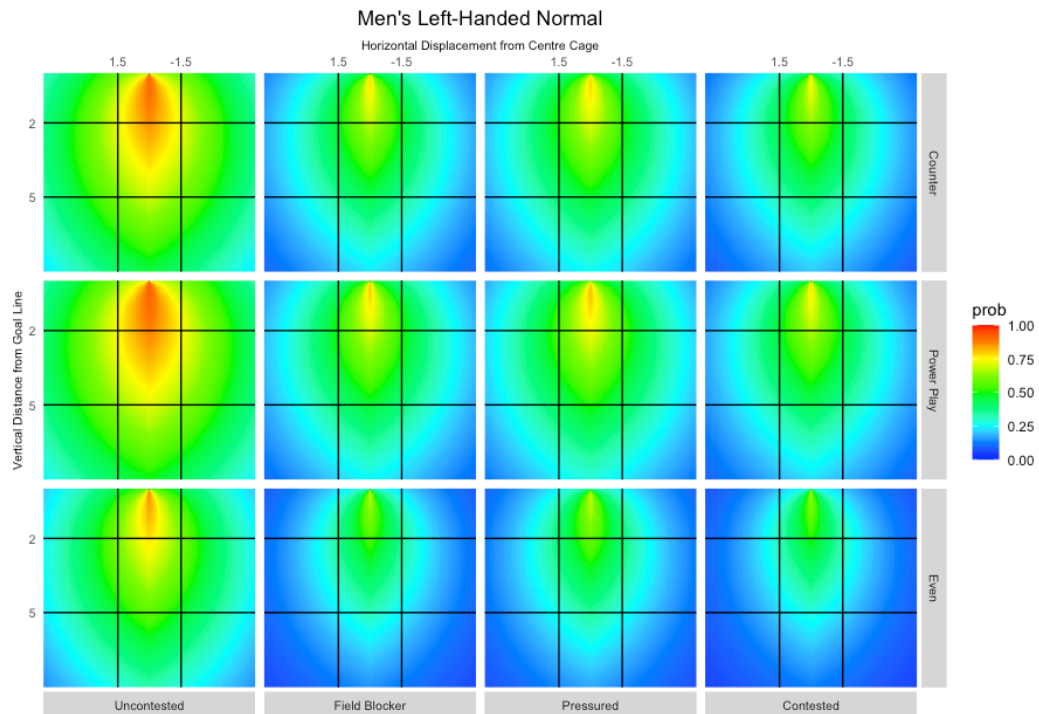
These plot comparisons reveals that for both men and women, the highest densities of right-handed shots and goals both occur near centre-pool just outside the five-meter line. However, for men, the highest density of left-handed shots occurs just outside the left edge of the goal a bit above the five-meter mark, while for women, the highest density of left-handed shots occurs between the five- and the three- meter mark. Both the highest density of goals for men and women occur between the two and five meter marks.

The symmetry of shots among the horizontal axis demonstrates the unimportance of the side feature for both sides.

5. Comparisons of Predicted Probability Heat Maps of Normal/Skip Shots Using Right/Left Hands Against Different Offensive/Defensive Scenarios

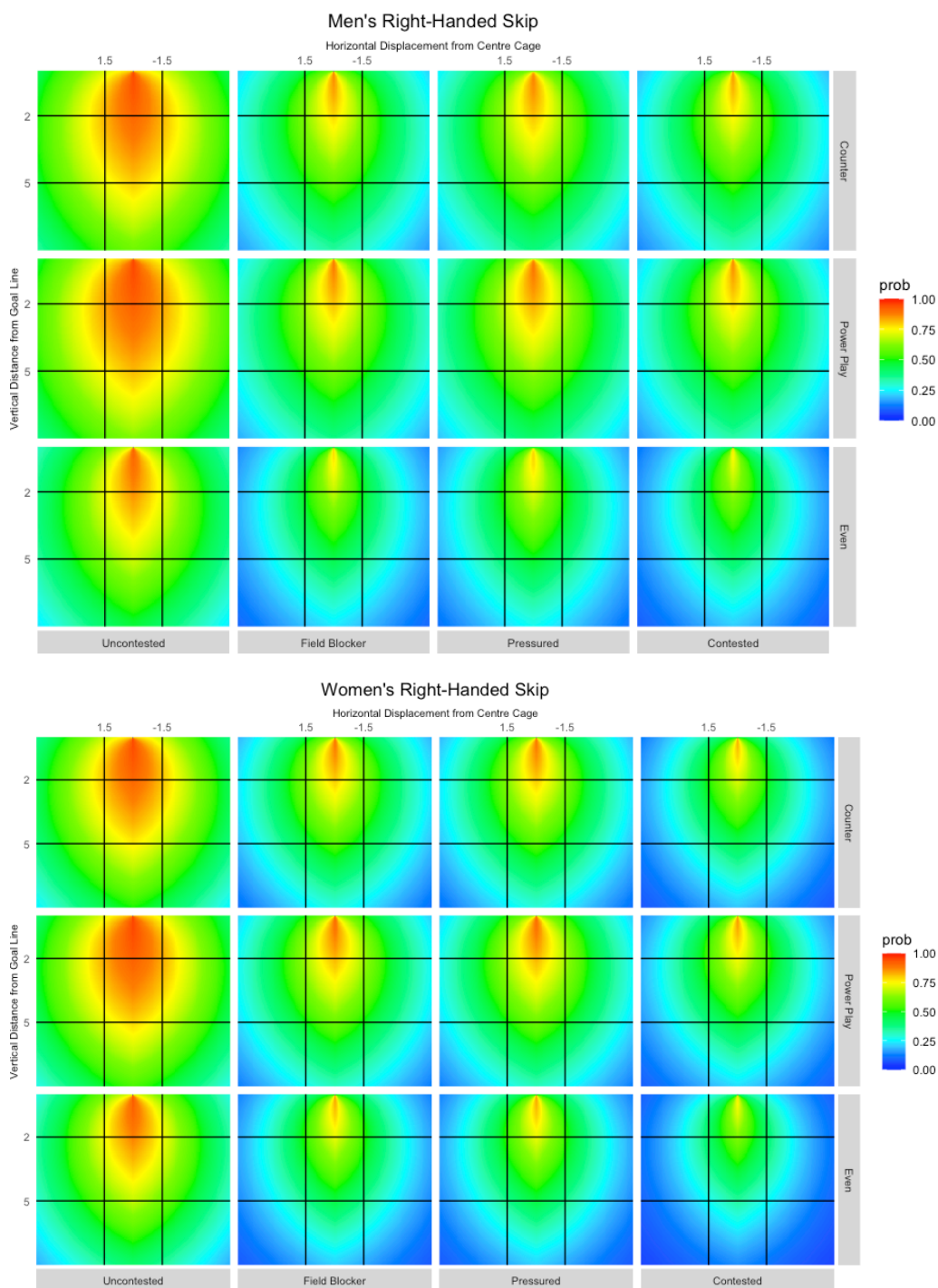


Heat maps of men's and women's predicted probabilities of getting a goal with right-handed normal shots

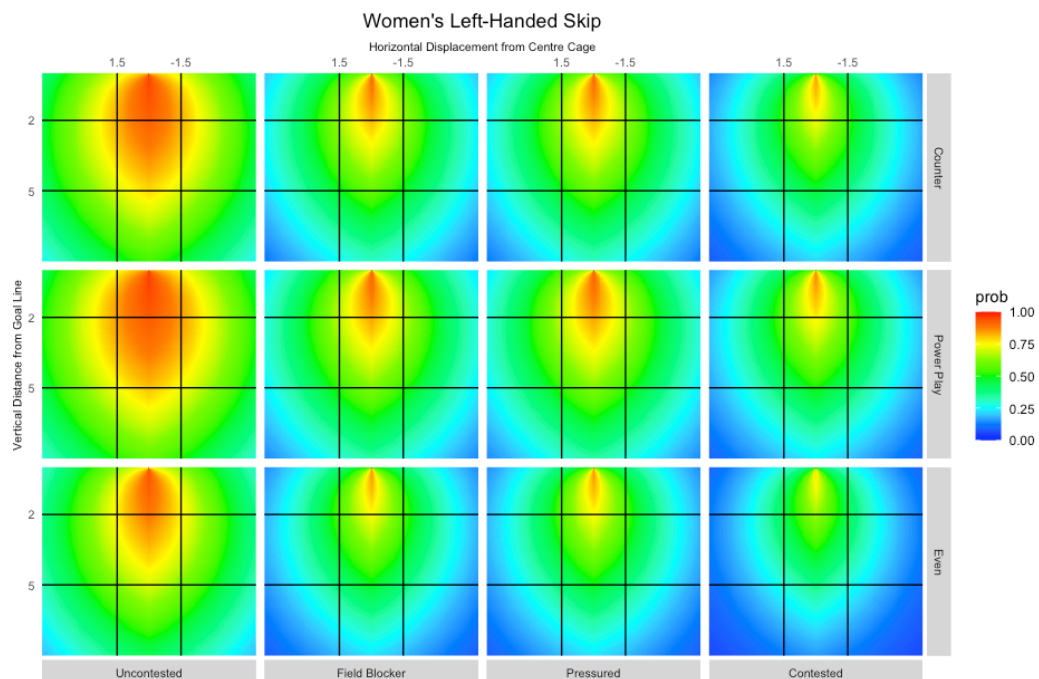
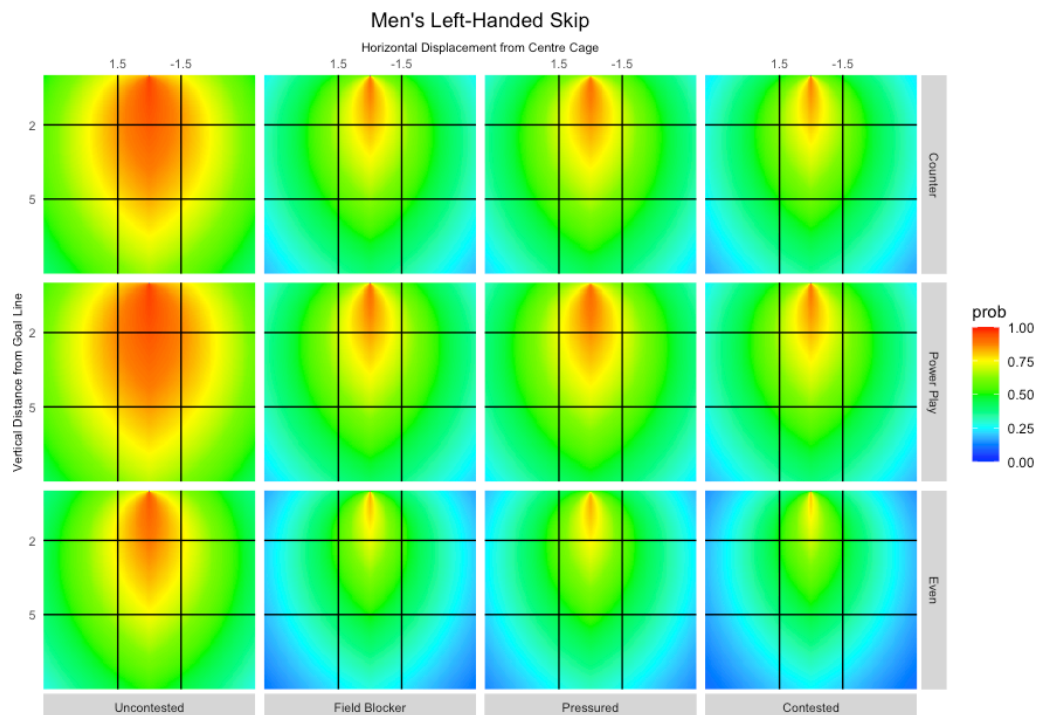


Heat maps of men's and women's predicted probabilities of getting a goal with left-handed normal shots

Skip Shot Type



Heat maps of men's and women's predicted probabilities of getting a goal with right-handed skip shots



Heat maps of men's and women's predicted probabilities of getting a goal with left-handed skip shots

Result

According to the heat-map comparisons for predicted probabilities of right/left-handed normal shots, it appears that women have a higher predicted probability of getting goals using normal shots for *uncontested*, *field blocker*, and *pressured* defensive scenarios and slightly for the *contested* defensive scenario.

Furthermore, according to the heat-maps for predicted probabilities of right-handed skip shots, it appears that both women and men have similar predicted probabilities of getting goal, though men have a higher probability in *power play/uncontested* and *counter/uncontested* scenarios. However, for left-handed skip shots, it appears that men have better shooting probabilities across all of the defensive and offensive scenarios, with the exception of the *Field Blocker* scenario, where both sides have nearly the same predicted probabilities.

According to these results, women teams have a higher probability of getting a score using normal shots in any of the offensive and defensive scenarios regardless of what hand they use with the exception of the *contested* scenario, where their probability is nearly the same as that of men teams. However, for left-handed skip shots, men teams have a higher predicted probability of getting a goal than women teams do.