

Data Science in Search for Best Predictions of **Ski Tour Difficulties**



KSFE 2022 in Wiesbaden
Datenanalyse 15.09 10:30-11:30

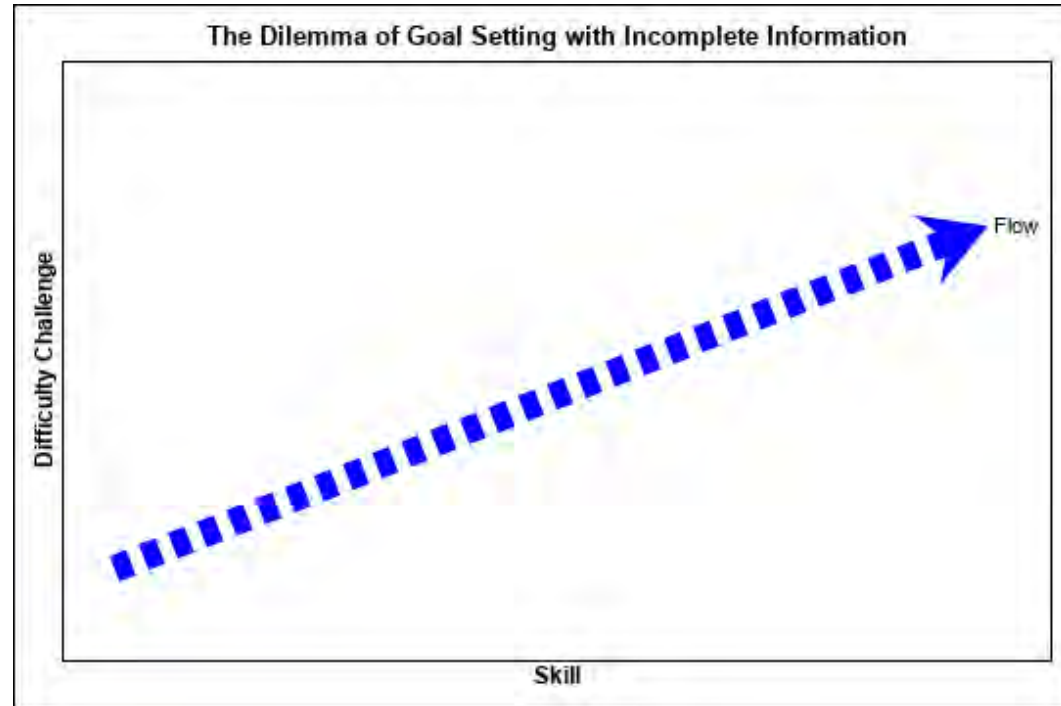
*Günter Schmudlach, Skitouren guru.ch
Ulrich Reincke, SAS Institute*

Difficulty of a ski tour

Why is it important?

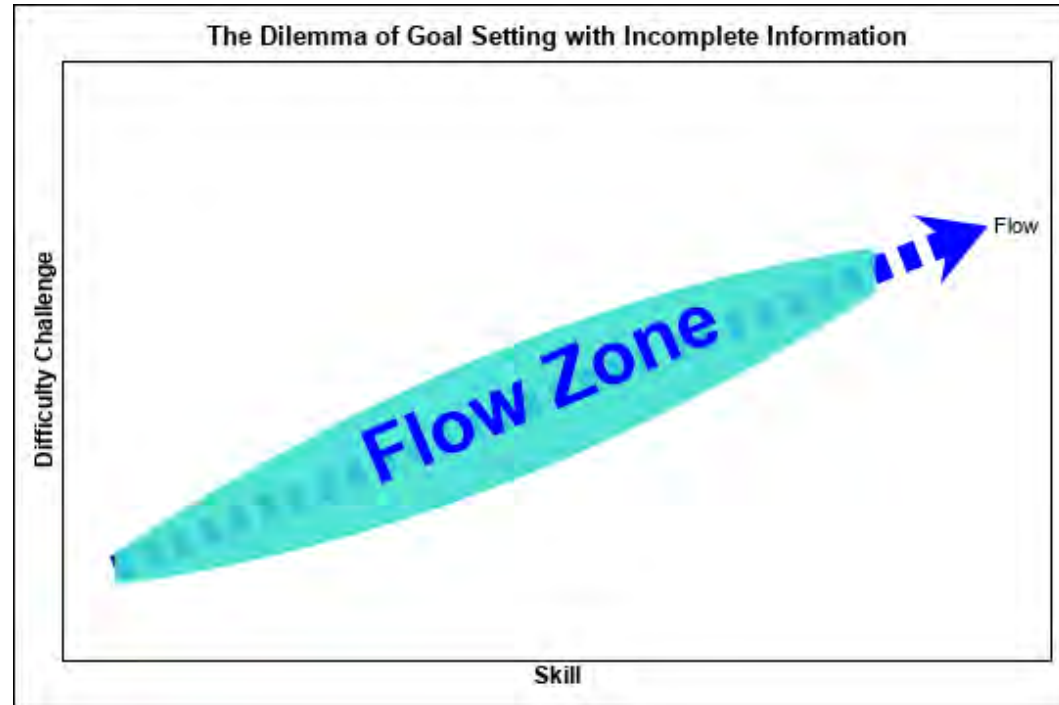
Difficulty of a ski tour

Why is it important?



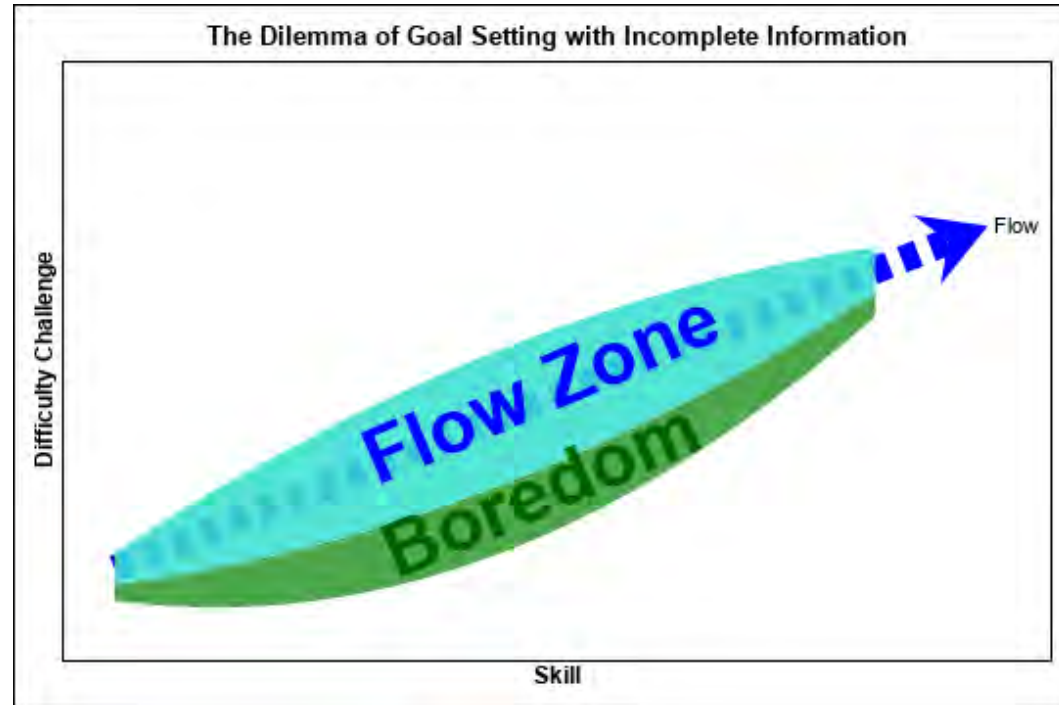
Difficulty of a ski tour

Why is it important?



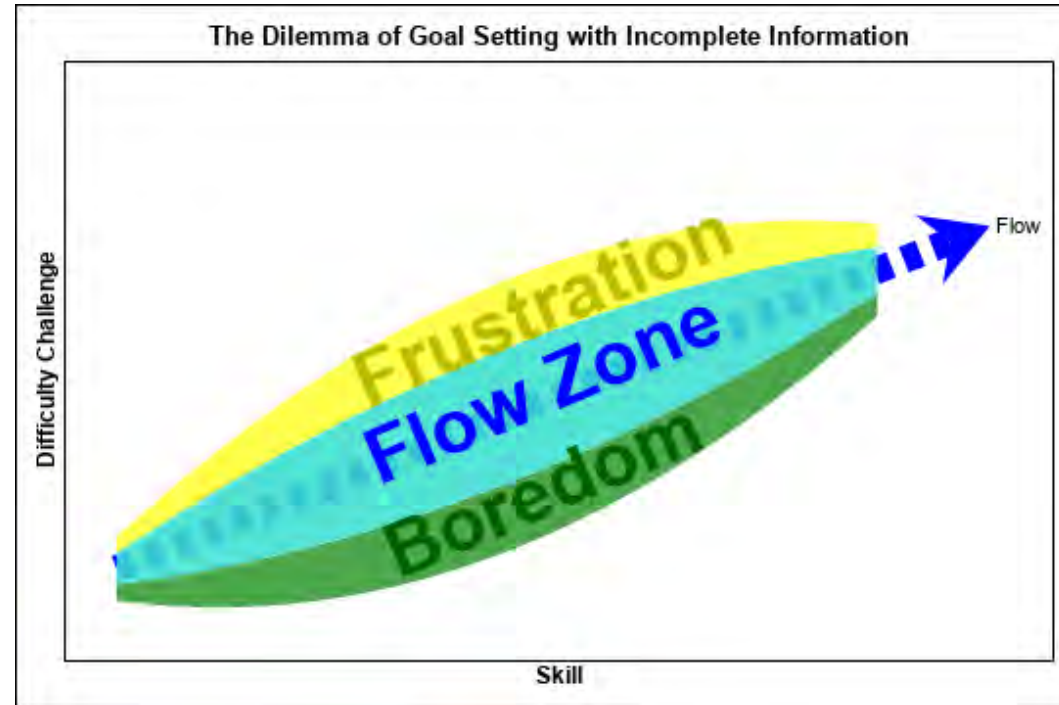
Difficulty of a ski tour

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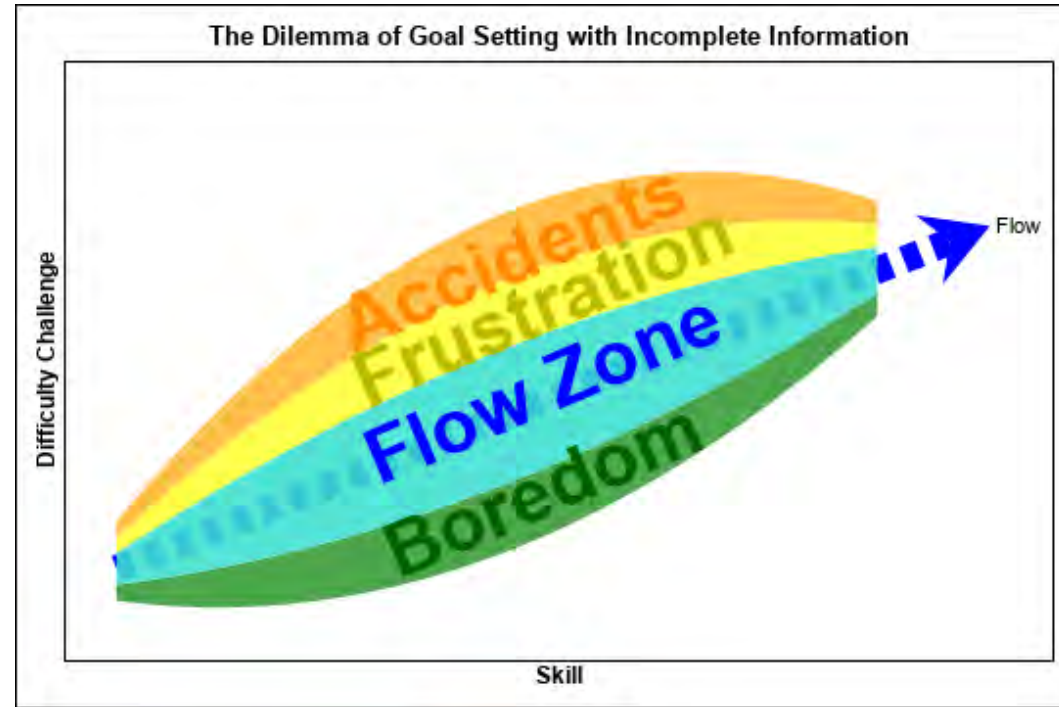
Difficulty of a ski tour

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Difficulty of a ski tour

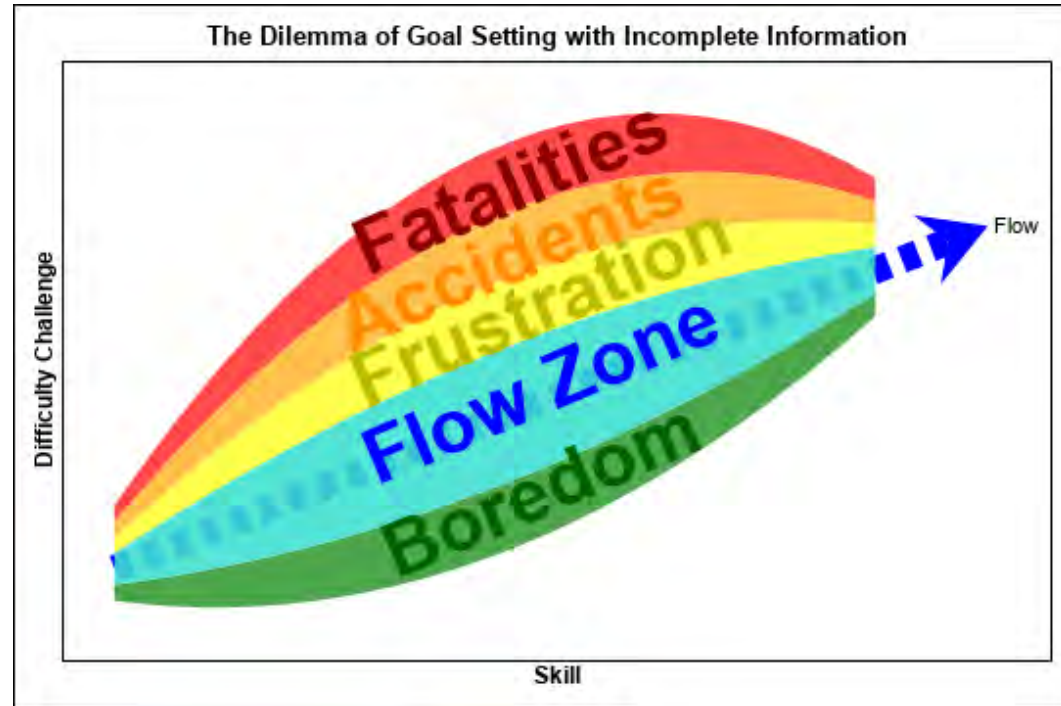
Why is it important?



Difficulty of a ski tour

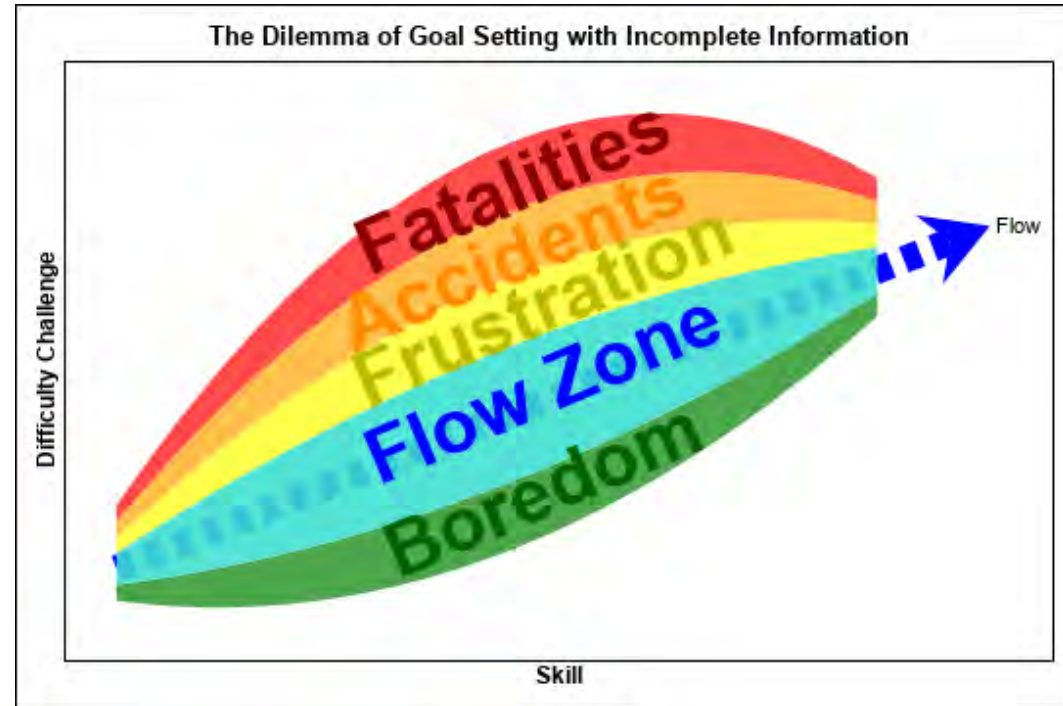
Why is it important?

Yearly official alpine accident statistics:
~70 fatalities of ~400 severe avalanche accidents
~25 fatalities of ~1000 severe ski tour accidents (non-avalanche)



Knowledge of a tour's difficulties is important for Better tour preparation, reduction of accidents and fatalities

Yearly official alpine accident statistics:
~70 fatalities of ~400 severe avalanche accidents
~25 fatalities of ~1000 severe ski tour accidents (non-avalanche)

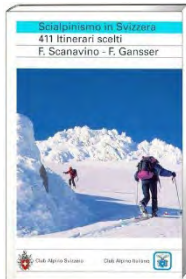


$$DIFFICULTY = f(\text{SlopeAngle, SpeedMax, Curvature, Forestation, ...})$$

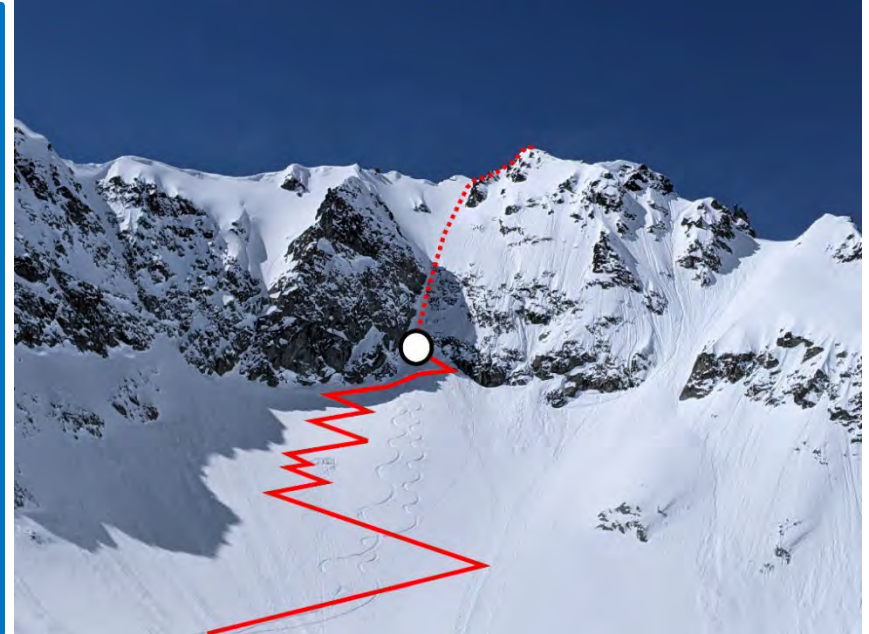
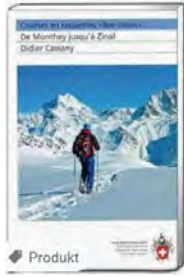
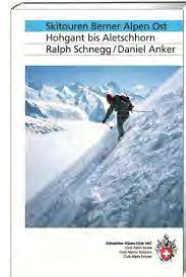
Dependent Variable: Difficulty

N=1307 Swiss Ski Tours,

Published in Swiss ski touring literature:



DIFFICULTY	DIFFICULTY LABEL
1	Easy
2	Easy (+)
3	Less Difficult(-)
4	Less Difficult
5	Less Difficult (+)
6	Quite Difficult (-)
7	Quite Difficult
8	Quite Difficult (+)
9	Difficult (-)
10	Difficult
11	Difficult (+)
12	Very Difficult (-)
13	Very Difficult
14	Very Difficult (+)
15	Extremely Difficult (-)
16	Extremely Difficult
17	Extremely Difficult (+)
18	Extremely Difficult



According to the SAC methodology, the difficulty level should only reflect the ski section of a tour up to the ski depot

Main criteria for the SAC difficulty scale

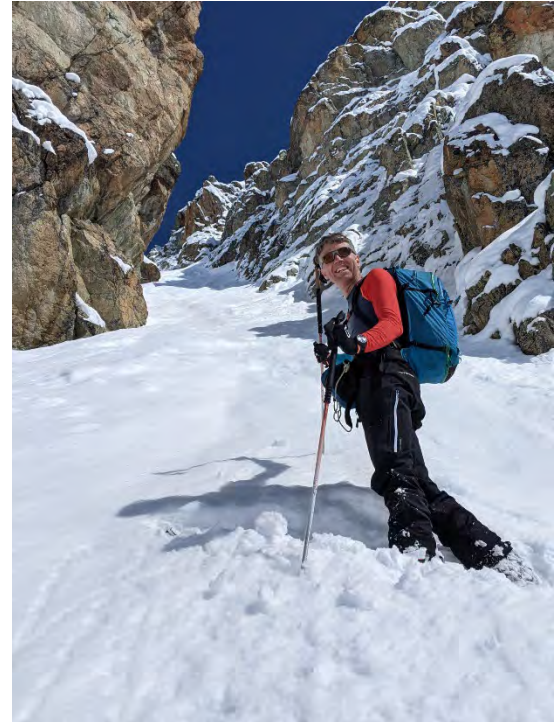
steepness, exposure to fall down, space conditions



steepness: slope angle



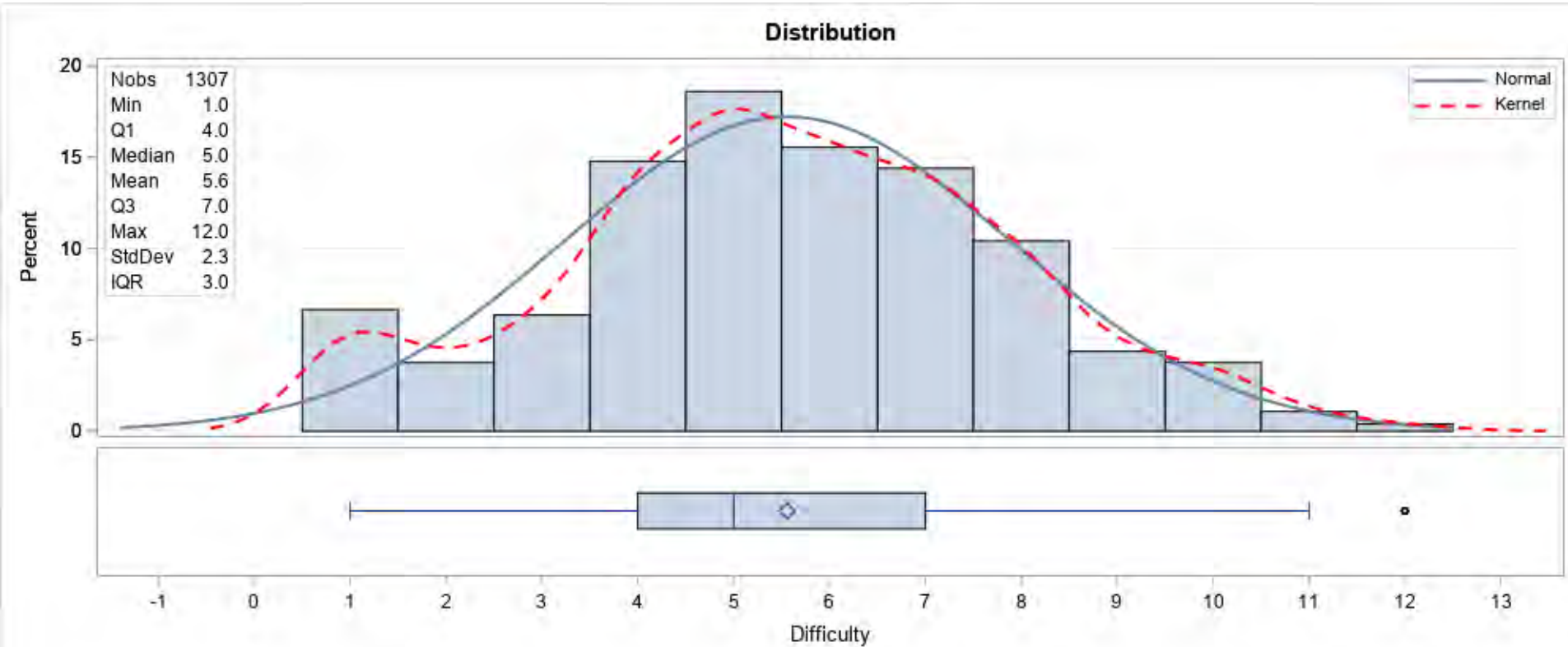
exposure to fall: speed max



space conditions: corridor width

target variable / dependent variable

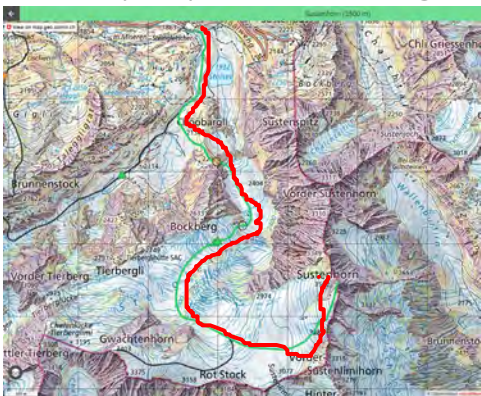
ski tour difficulty from SAC literature



Data preparation: from properties to prediction features

N=1307 Swiss tours, ~9.3 mill. track meters

Local properties along each **Track**:

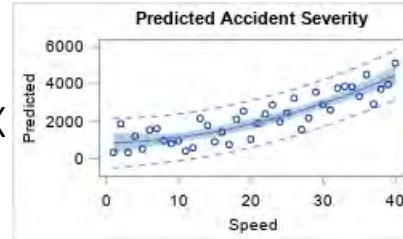
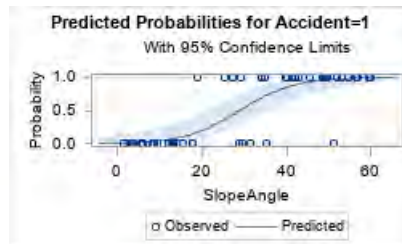
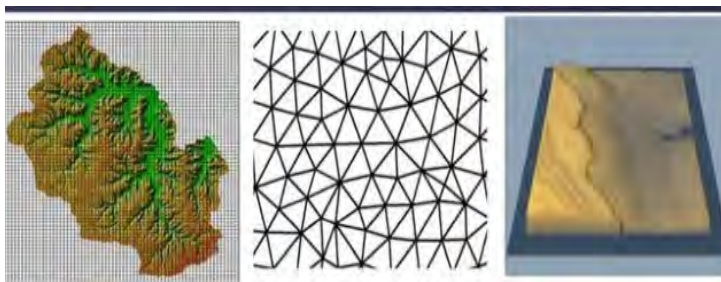


Properties:

- SlopeAngle (x,y) „steepness“
- SpeedMax (x,y) „exposure to fall“
- Width (x,y) „space conditions“
- Forestation (x,y)
- Curvature (x,y)
- Fold (x,y)

$$-Risk(x,y) := SlopeAngle(x,y) * SpeedMax(x,y)$$

Digital Landscape Model 10m*10m



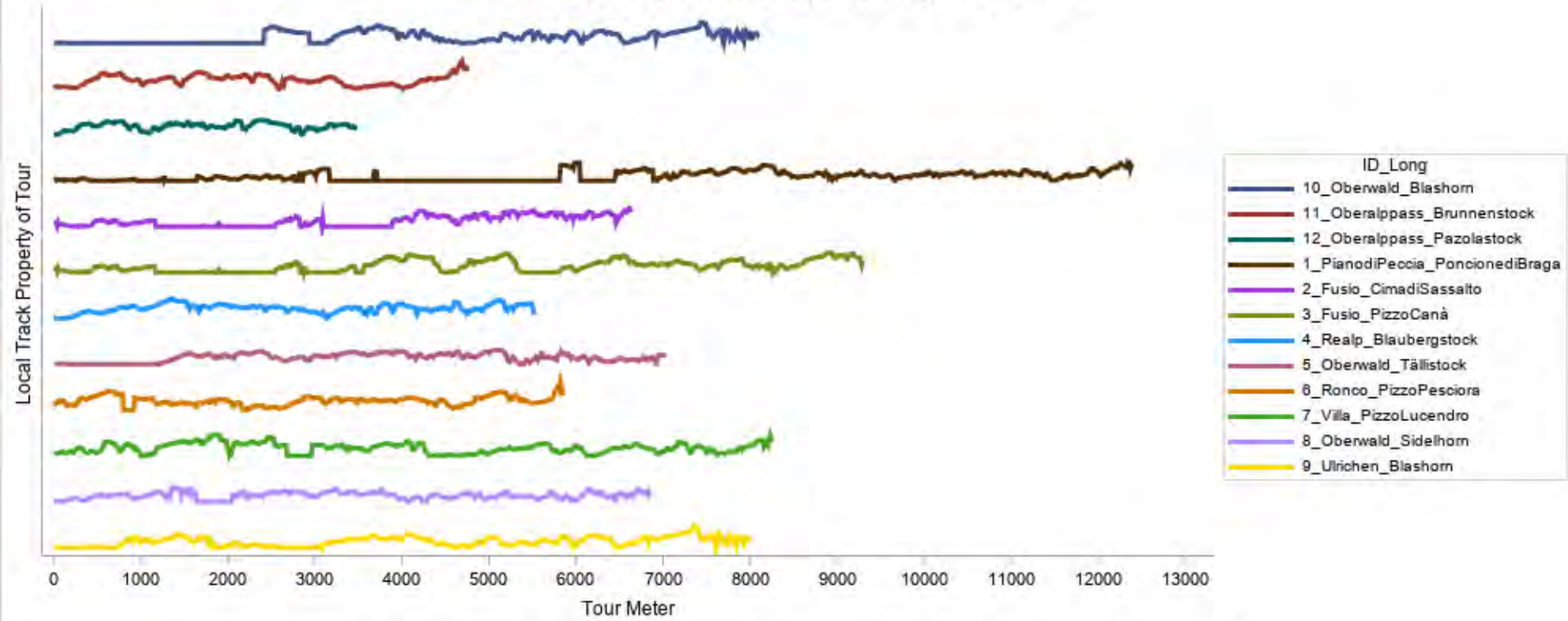
Data preparation

from local track properties to unique tour features

Data preparation

from local track properties to unique tour features

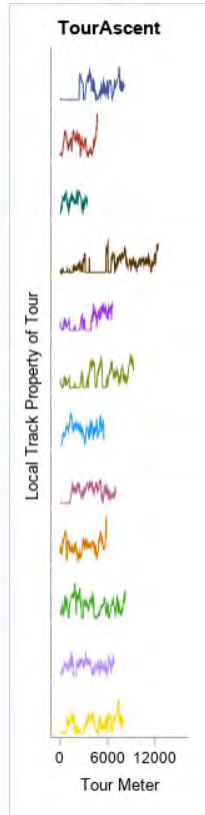
Illustrative example of a local property along tours in ascent



Local track properties of tours processed: Risk, Slope Angle, SpeedMax, Acceleration, Forestation, Curvature, Width,...

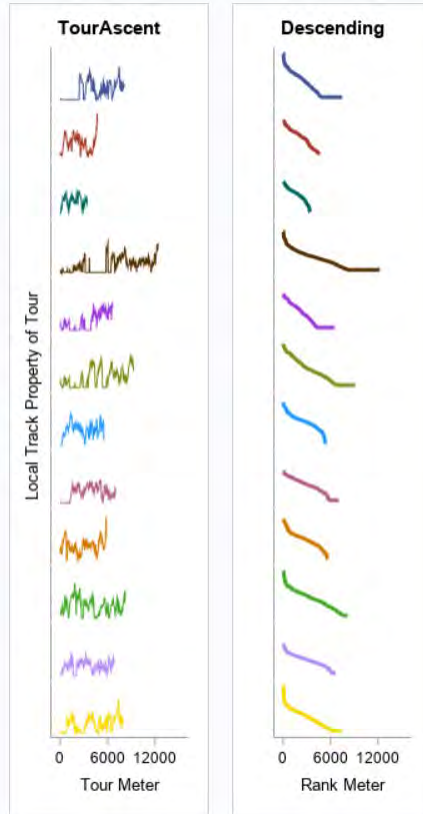
Data preparation

from local track properties to unique tour features



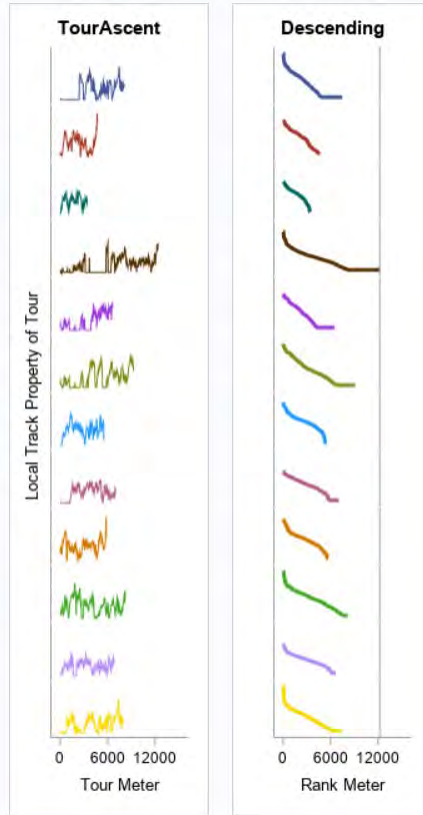
Data preparation

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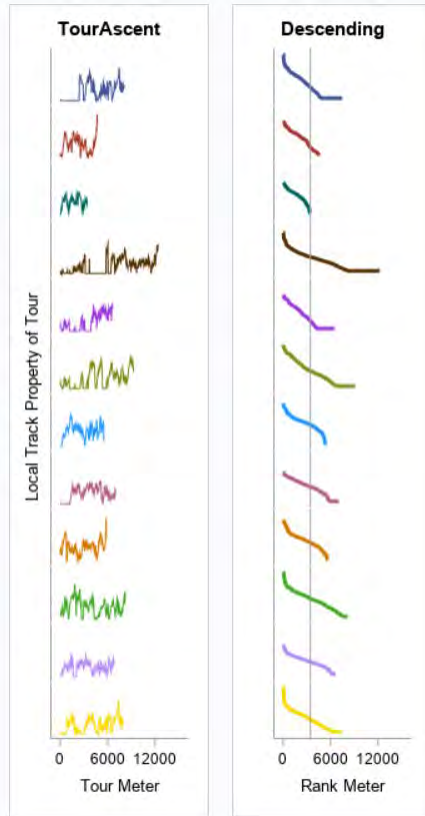
Data preparation

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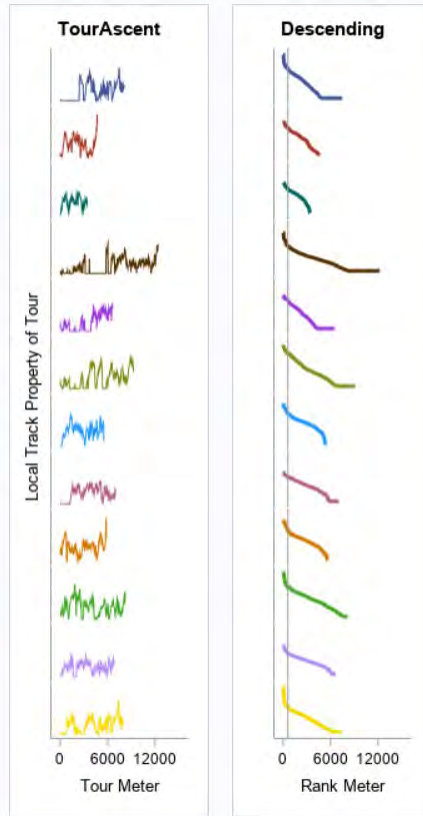
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from local track properties to unique tour features



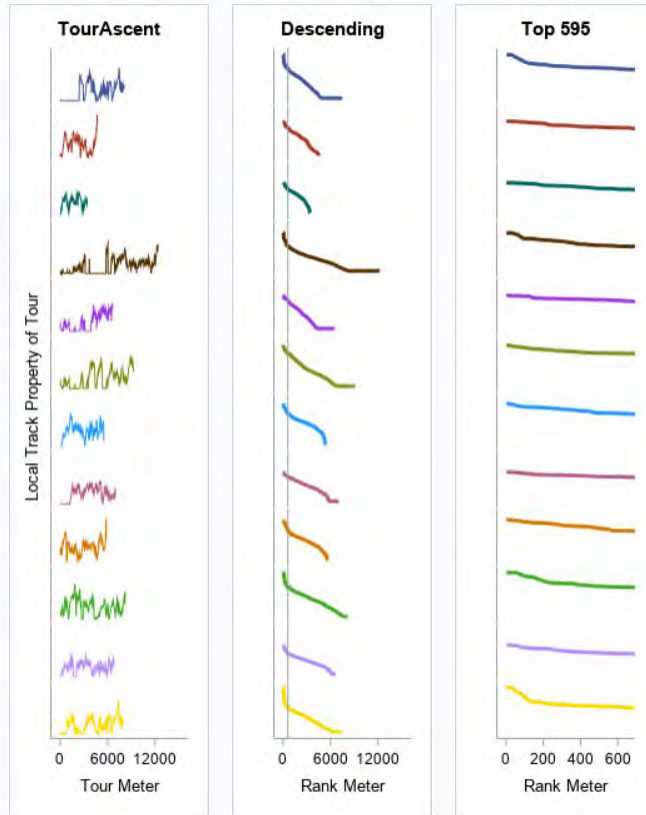
Data preparation

from local track properties to unique tour features



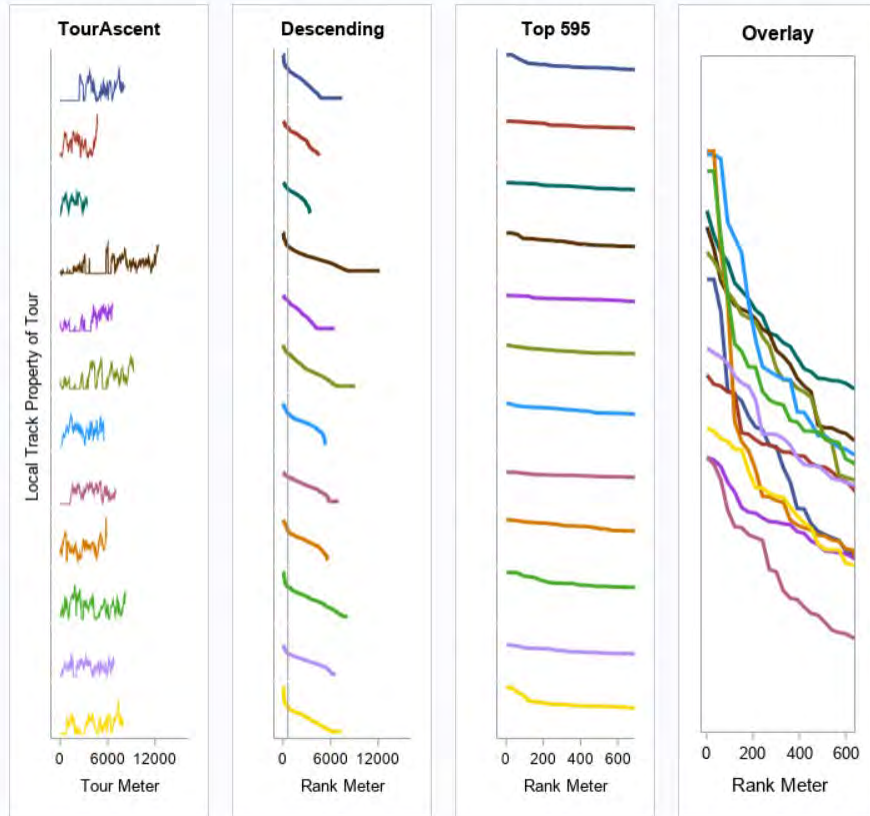
Data preparation

from local track properties to unique tour features



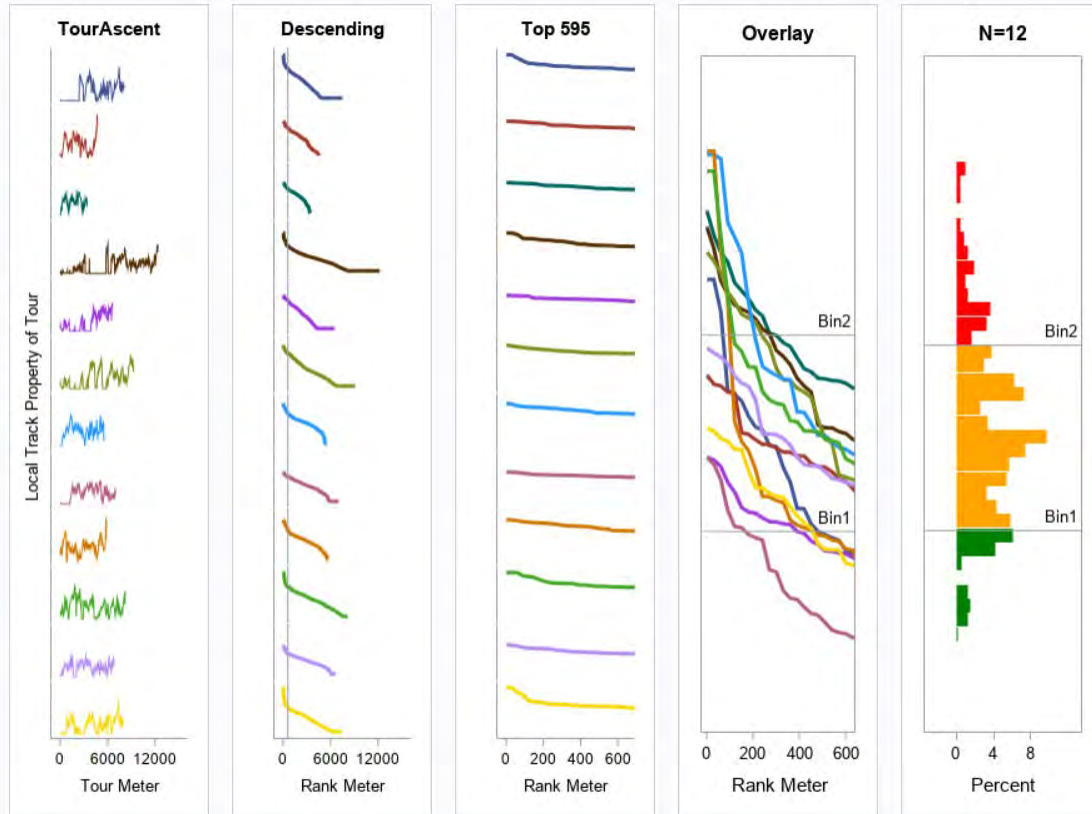
Data preparation

from local track properties to unique tour features



Data preparation

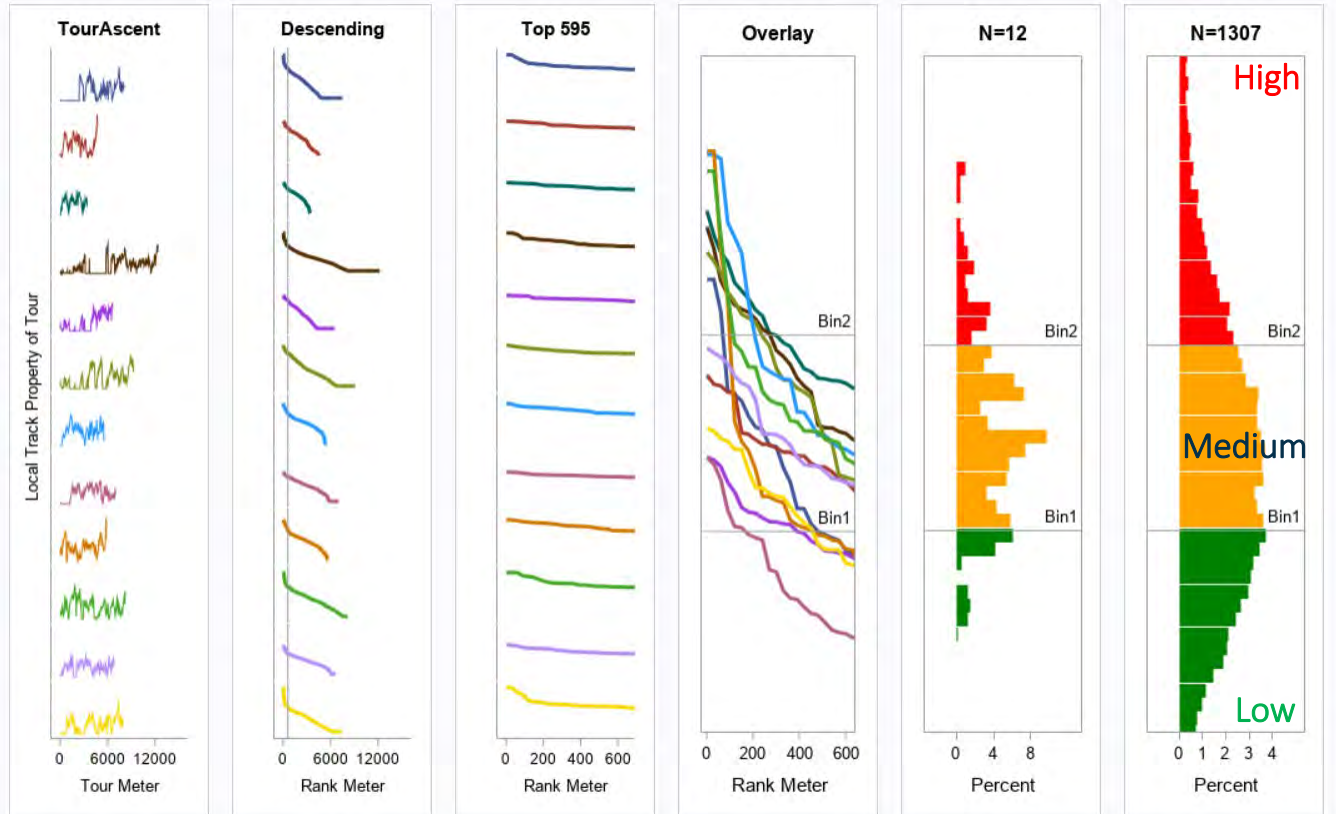
from local track properties to unique tour features



Local track properties of tours processed: Risk, Slope Angle, SpeedMax, Acceleration, Forestation, Curvature, Width,...

Data preparation

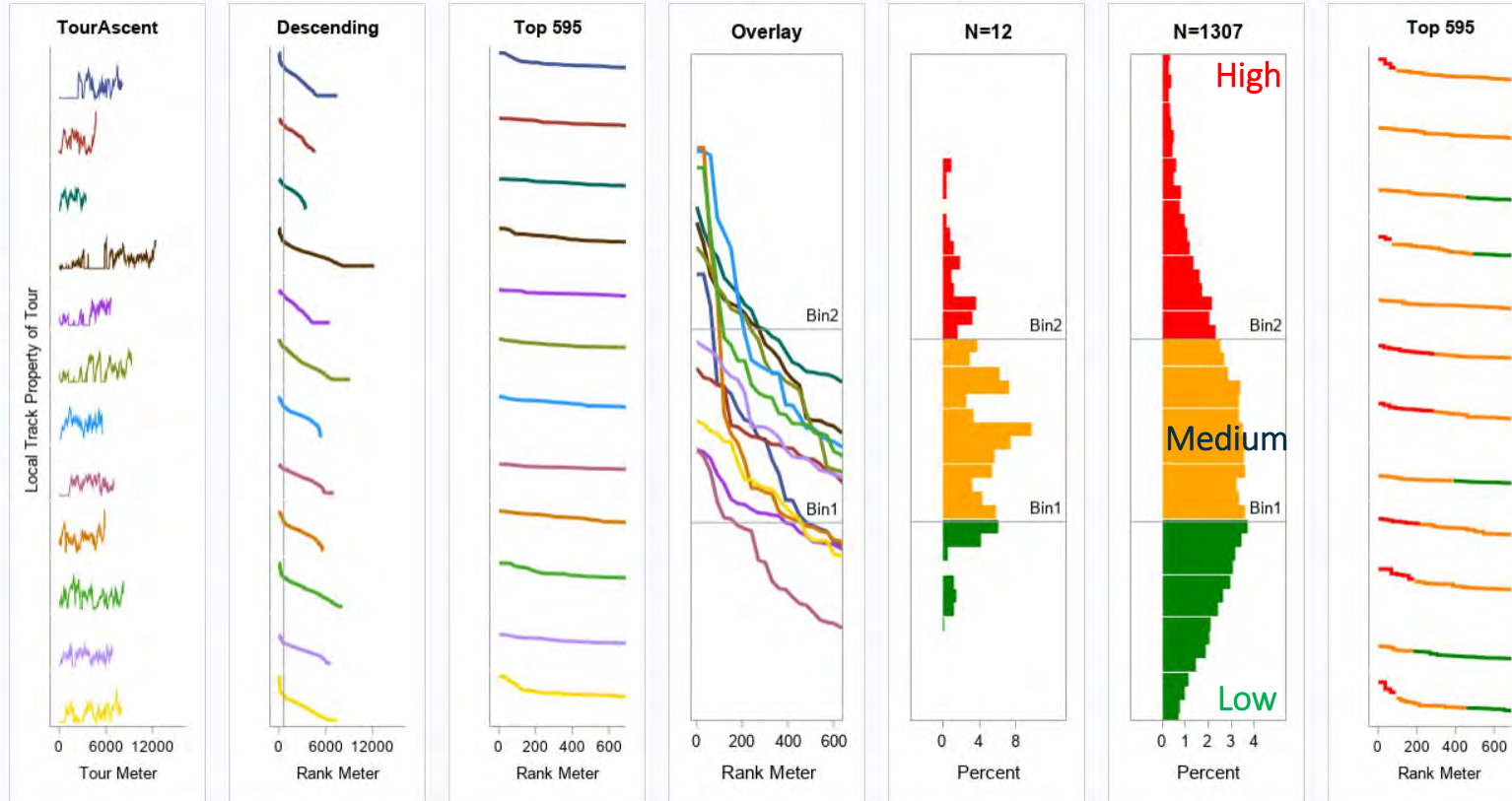
from local track properties to unique tour features



Local track properties of tours processed: Risk, Slope Angle, SpeedMax, Acceleration, Forestation, Curvature, Width,...

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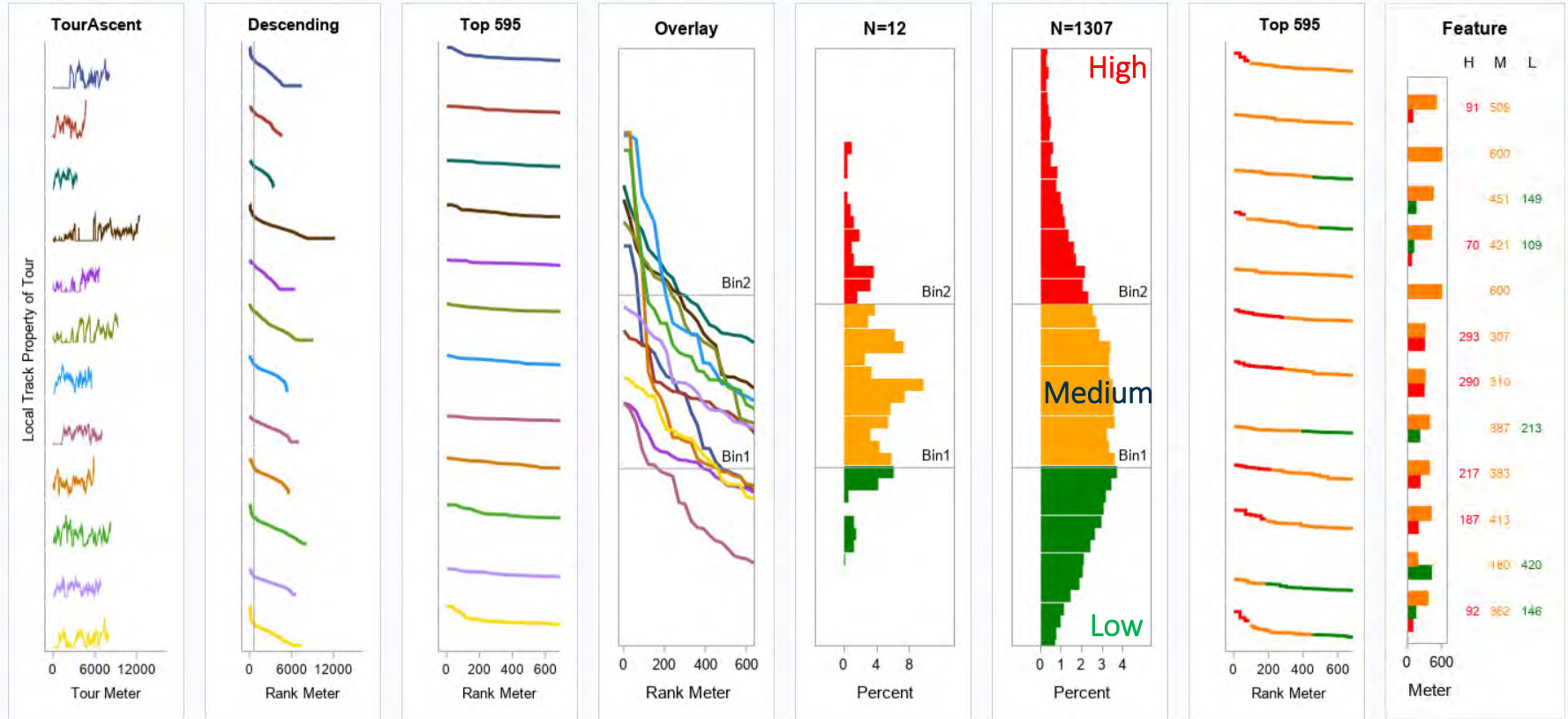
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Local track properties of tours processed: Risk, Slope Angle, SpeedMax, Acceleration, Forestation, Curvature, Width,...

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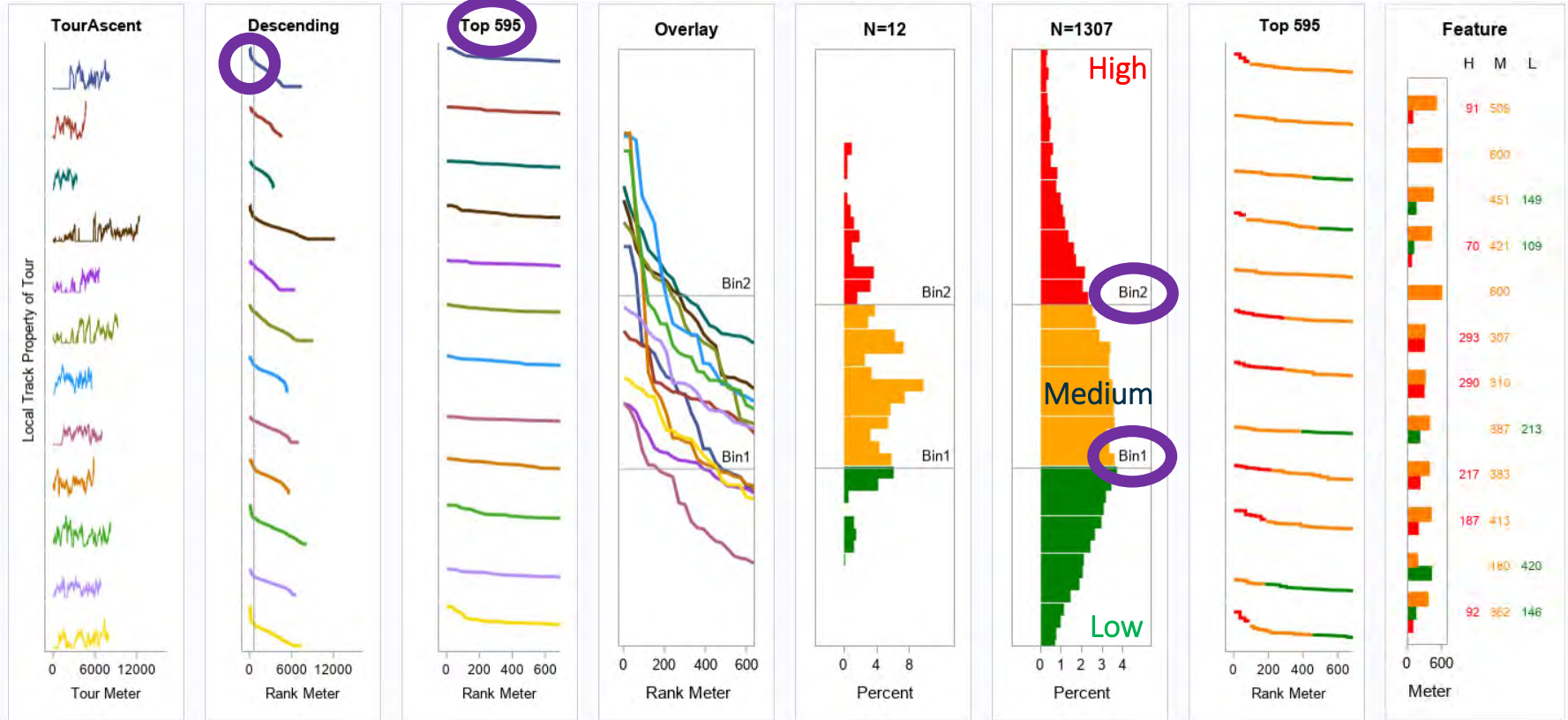
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Local track properties of tours processed: Risk, Slope Angle, SpeedMax, Acceleration, Forestation, Curvature, Width,...

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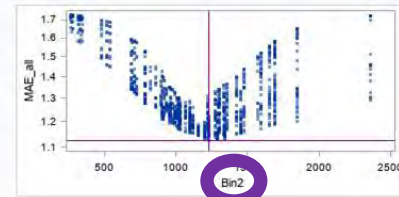
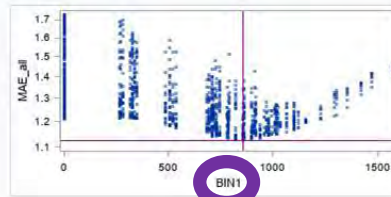
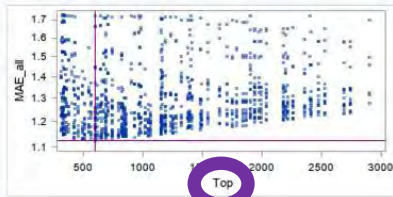
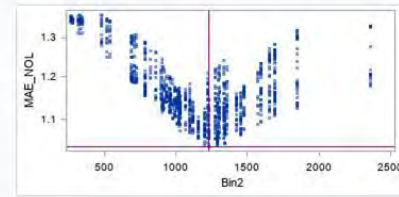
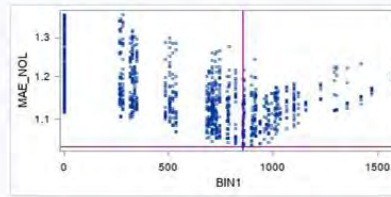
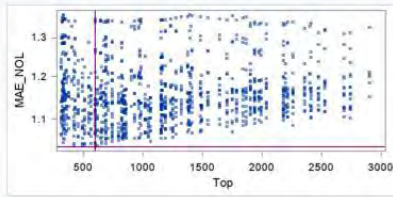
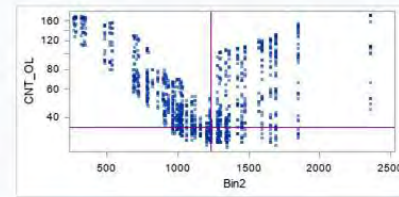
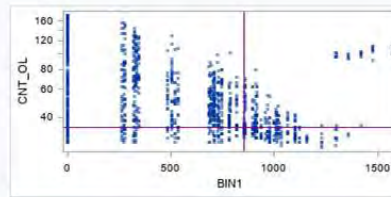
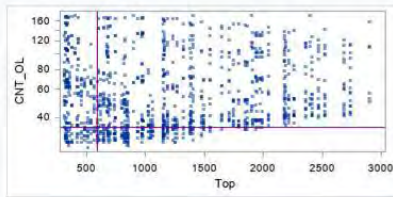


Local track properties of tours processed: Risk, Slope Angle, SpeedMax, Acceleration, Forestation, Curvature, Width,...

How to find good segmentation parameters: **Top, Bin1, Bin2** „Trial and Error“ minimizing Mean Absolute Prediction Error MAE

Optimal quantile regression model with best segmentation parameter TOP, BIN1, BIN2 (out of 5000 trials)

Top	BIN1	Bin2	Opt	MAE_all	MAE_NOL	CNT_OL	Intercept	RiskCnt_3	RiskCnt_3f	RiskCnt_2	RiskCnt_2f	SAC3_BEE_BEW_BVS_FRV	SAC3_TI	SAC3_ZS_GRN_GRS_GL_V
595	855	1229	*	1.12596	1.03841	35	1.83060	0.00866	0.00686	0.00464	-	-0.83060	0.67489	0



from 7 properties to 107 „best“ features

Sample of original local properties along the tour track

ID_Long	Meter	Speed	SlopeAngle	Forestation	Fold	Curvature	Acceleration	Width
1000_Sagliai..._PizZadrell	1	25	22.9	0.0	-15.45	-2.00	13	135
1000_Sagliai..._PizZadrell	2	25	22.9	0.0	-15.45	-2.00	13	135
1000_Sagliai..._PizZadrell	3	25	22.9	0.0	-15.45	-2.00	13	135
1000_Sagliai..._PizZadrell	4	25	22.9	0.0	-15.45	-2.00	13	135
1000_Sagliai..._PizZadrell	5	25	22.9	0.0	-15.45	-2.00	13	135
1000_Sagliai..._PizZadrell	6	25	22.9	0.0	-15.45	-2.00	13	135
1000_Sagliai..._PizZadrell	7	25	22.9	0.0	-15.45	-2.00	13	135
1000_Sagliai..._PizZadrell	8	25	22.9	0.0	-15.45	-2.00	13	135
1000_Sagliai..._PizZadrell	9	25	22.9	0.0	-15.45	-2.00	13	135
1000_Sagliai..._PizZadrell	10	25	22.9	0.0	-15.45	-2.00	13	135
1000_Sagliai..._PizZadrell	11	25	22.9	0.0	-15.45	-2.00	13	135
1000_Sagliai..._PizZadrell	12	25	22.9	0.0	-15.45	-2.00	13	135
1000_Sagliai..._PizZadrell	13	25	22.9	0.0	-15.45	-2.00	13	135
1000_Sagliai..._PizZadrell	14	25	22.9	0.0	-15.45	-2.00	13	135
1000_Sagliai..._PizZadrell	15	25	23.0	0.0	-12.78	-5.53	13	147
1000_Sagliai..._PizZadrell	16	25	23.0	0.0	-12.78	-5.53	13	147
1000_Sagliai..._PizZadrell	17	25	23.0	0.0	-12.78	-5.53	13	147
1000_Sagliai..._PizZadrell	18	25	23.0	0.0	-12.78	-5.53	13	147
1000_Sagliai..._PizZadrell	19	25	23.0	0.0	-12.78	-5.53	13	147
1000_Sagliai..._PizZadrell	20	25	23.0	0.0	-12.78	-5.53	13	147
1000_Sagliai..._PizZadrell	21	25	23.0	0.0	-12.78	-5.53	13	147
1000_Sagliai..._PizZadrell	22	25	23.0	0.0	-12.78	-5.53	13	147
1000_Sagliai..._PizZadrell	23	25	23.0	0.0	-12.78	-5.53	13	147
1000_Sagliai..._PizZadrell	24	25	23.0	0.0	-12.78	-5.53	13	147

$$\sum x_i \beta_i \quad \sum x_i \beta_i \quad \sum x_i \beta_i \quad \sum x_i \beta_i \quad \sum x_i \beta_i \quad \sum x_i \beta_i \quad \sum x_i \beta_i$$



Final list of prediction feature candidates

VARNUM	NAME	VARNUM	NAME	VARNUM	NAME
1	TRN_VAL_Flag	36	ACCELS_L_Meter_Foot	72	FORESTSLOPE_L_Meter_Foot
2	Target_Difficulty	37	ACCELS_M_Meter_Foot	73	FORESTSLOPE_M_Meter_Foot
3	id	38	ACCELS_H_Meter_Foot	74	FORESTSLOPE_H_Meter_Foot
4	id_long	39	CURVN_L_Meter_Ski	75	RISK_L_Meter_Ski
5	url	40	CURVN_M_Meter_Ski	76	RISK_M_Meter_Ski
6	x	41	CURVN_H_Meter_Ski	77	RISK_H_Meter_Ski
7	y	42	CURVN_L_Meter_Foot	78	RISK_L_Meter_Foot
8	z	43	CURVN_M_Meter_Foot	79	RISK_M_Meter_Foot
9	count_fm	44	CURVN_H_Meter_Foot	80	RISK_H_Meter_Foot
10	count_am	45	CURVP_L_Meter_Ski	81	SLOPE_L_Meter_Ski
11	count_sm	46	CURVP_M_Meter_Ski	82	SLOPE_M_Meter_Ski
12	start	47	CURVP_H_Meter_Ski	83	SLOPE_H_Meter_Ski
13	end	48	CURVP_L_Meter_Foot	84	SLOPE_L_Meter_Foot
14	StartEle	49	CURVP_M_Meter_Foot	85	SLOPE_M_Meter_Foot
15	StopEle	50	CURVP_H_Meter_Foot	86	SLOPE_H_Meter_Foot
16	Ele	51	FOLDN_L_Meter_Ski	87	SPEEDM_L_Meter_Ski
17	SAC	52	FOLDN_M_Meter_Ski	88	SPEEDM_M_Meter_Ski
18	SAC0	53	FOLDN_H_Meter_Ski	89	SPEEDM_H_Meter_Ski
19	SAC1	54	FOLDN_L_Meter_Foot	90	SPEEDM_L_Meter_Foot
20	SAC2	55	FOLDN_M_Meter_Foot	91	SPEEDM_M_Meter_Foot
21	SAC3	56	FOLDN_H_Meter_Foot	92	SPEEDM_H_Meter_Foot
22	ACCELM_L_Meter_Ski	57	FOLDP_L_Meter_Ski	93	SPEEDS_L_Meter_Ski
23	ACCELM_M_Meter_Ski	58	FOLDP_M_Meter_Ski	94	SPEEDS_M_Meter_Ski
24	ACCELM_H_Meter_Ski	59	FOLDP_H_Meter_Ski	95	SPEEDS_H_Meter_Ski
25	ACCELM_L_Meter_Foot	60	FOLDP_L_Meter_Foot	96	SPEEDS_L_Meter_Foot
26	ACCELM_M_Meter_Foot	61	FOLDP_M_Meter_Foot	97	SPEEDS_M_Meter_Foot
27	ACCELM_H_Meter_Foot	62	FOLDP_H_Meter_Foot	98	SPEEDS_H_Meter_Foot
28	SAC_Vol	63	FOREST_L_Meter_Ski	99	WIDTH_L_Meter_Ski
29	Meter	64	FOREST_M_Meter_Ski	100	WIDTH_M_Meter_Ski
30	Mode	65	FOREST_H_Meter_Ski	101	WIDTH_H_Meter_Ski
31	Outlier_code	66	FOREST_L_Meter_Foot	102	WIDTH_L_Meter_Foot
32	Outlier_Comment	67	FOREST_M_Meter_Foot	103	WIDTH_M_Meter_Foot
33	ACCELS_L_Meter_Ski	68	FOREST_H_Meter_Foot	104	WIDTH_H_Meter_Foot
34	ACCELS_M_Meter_Ski	69	FORESTSLOPE_L_Meter_Ski	105	Author_Grp_Bias
35	ACCELS_H_Meter_Ski	70	FORESTSLOPE_M_Meter_Ski	106	SelectionProb
		71	FORESTSLOPE_H_Meter_Ski	107	Sampling/Weight

Counting your steps like the fitness app of your smart phone



Risk

Slope

SpeedM

RISK_L_Meter_Ski



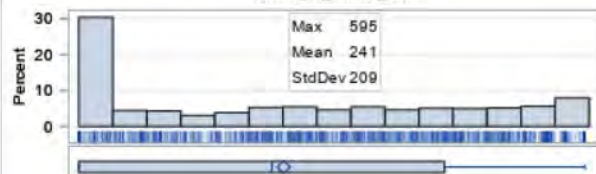
SLOPE_L_Meter_Ski



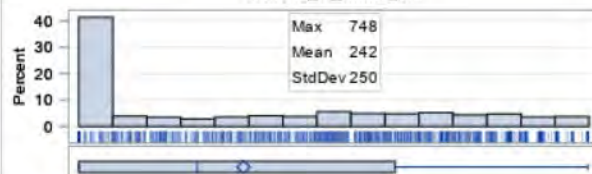
SPEEDM_L_Meter_Ski



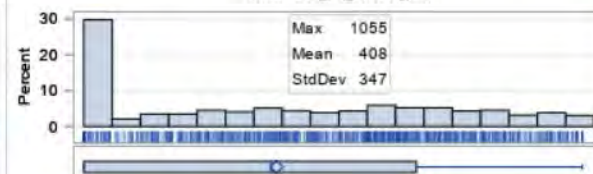
RISK_M_Meter_Ski



SLOPE_M_Meter_Ski



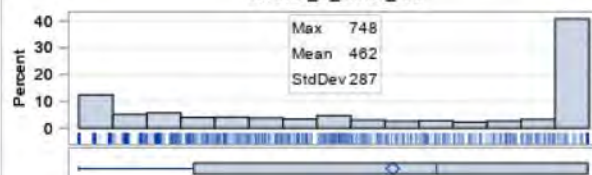
SPEEDM_M_Meter_Ski



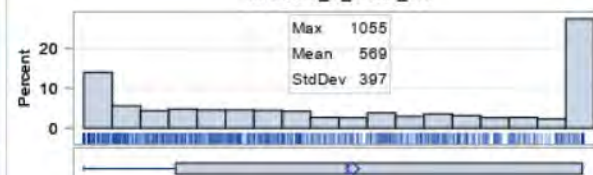
RISK_H_Meter_Ski



SLOPE_H_Meter_Ski



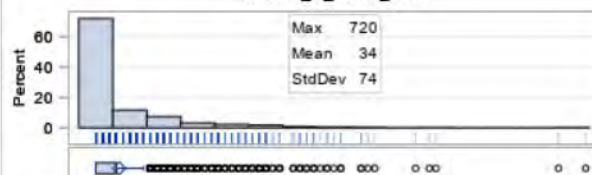
SPEEDM_H_Meter_Ski



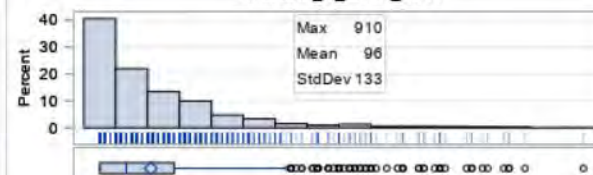
RISK_H_Meter_Foot



SLOPE_H_Meter_Foot



SPEEDM_H_Meter_Foot



L

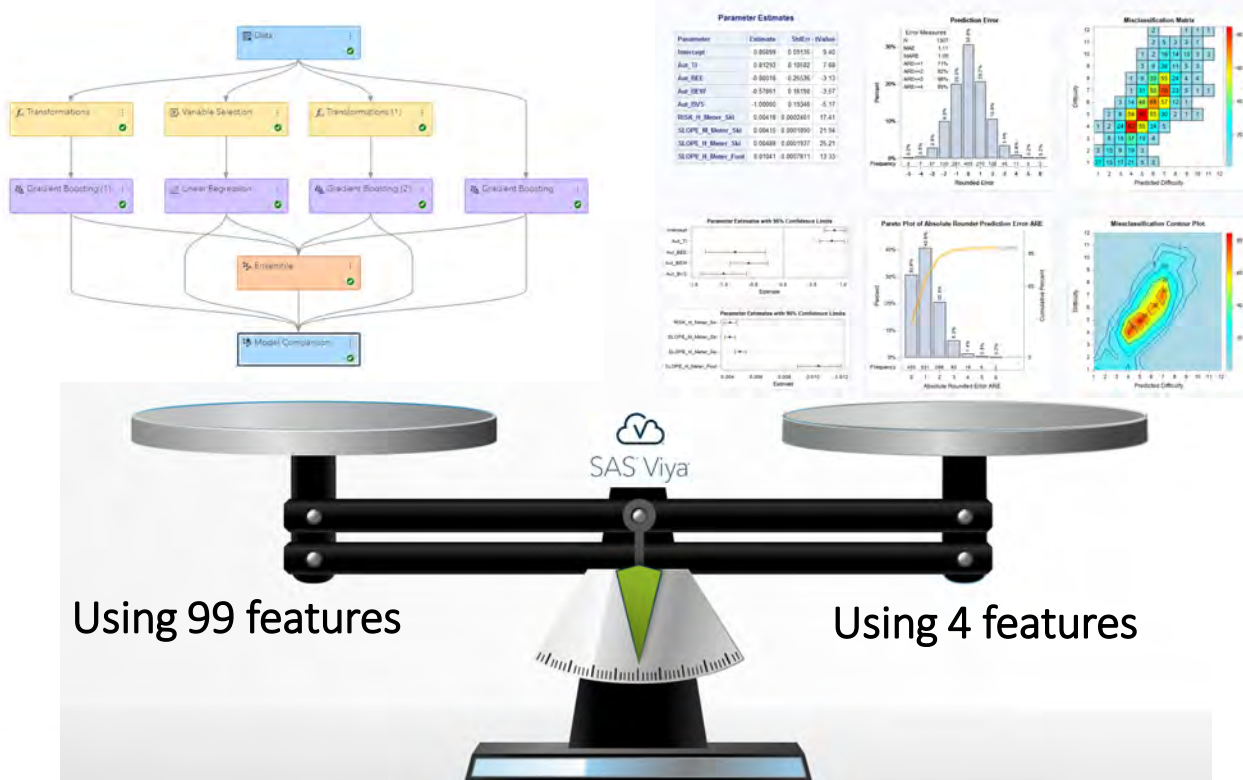
M

H

Foot

What predictive modeling approach did we take?

Machine Learning vs. Statistical Model

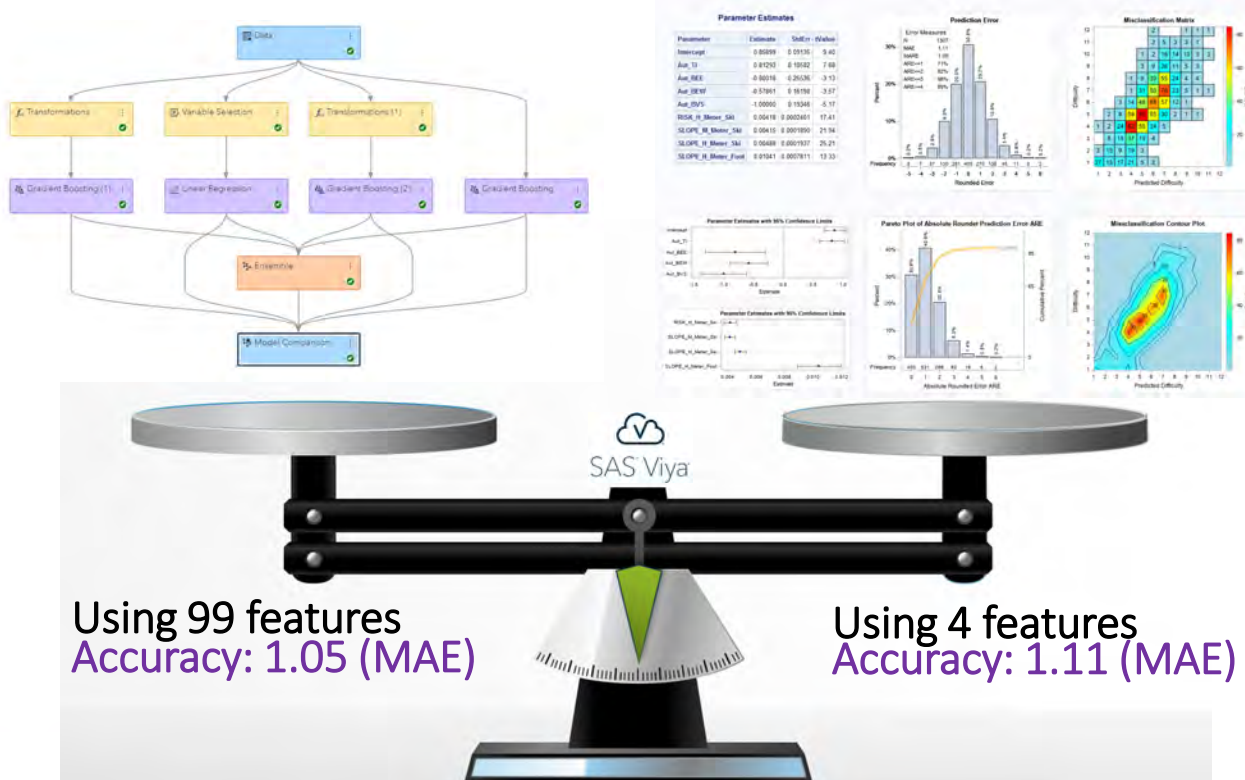


Using 99 features

Using 4 features

What predictive modeling approach did we take?

Machine Learning vs. Statistical Model



Using 99 features
Accuracy: 1.05 (MAE)

Using 4 features
Accuracy: 1.11 (MAE)

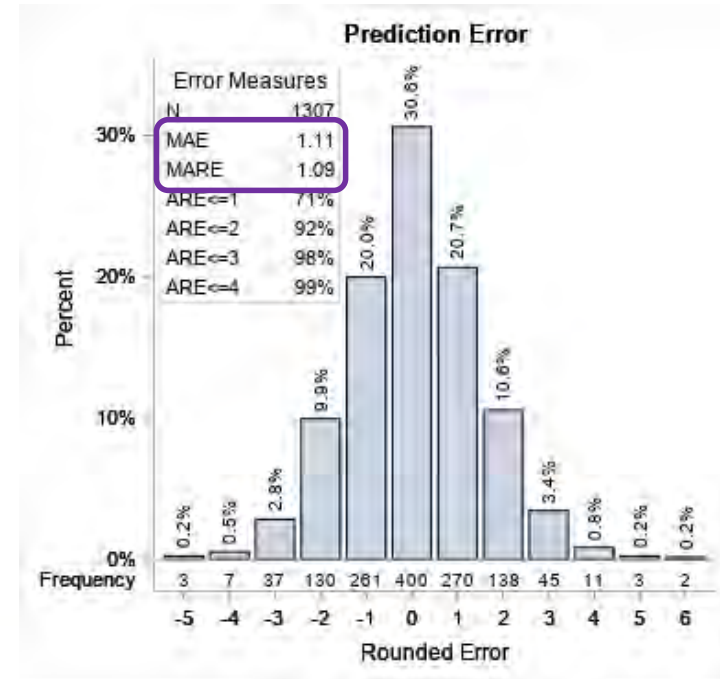
Variable selection with quantile regression

For median of difficulty

The HPQUANTSELECT Procedure
Quantile Level = 0.5

Selection Summary				
Step	Effect Entered	Number Effects In	AIC	SBC
0	Intercept	1	-185.5716	-180.3961
1	RISK_H_Meter_Ski	2	-984.6951	-974.3442
2	SLOPE_H_Meter_Foot	3	-1216.9940	-1201.4675
3	Aut_BVS	4	-1246.9930	-1226.2911
4	Aut_BEW	5	-1277.7180	-1251.8405
5	SLOPE_H_Meter_Ski	6	-1307.2939	-1276.2410
6	SLOPE_M_Meter_Ski	7	-1484.6233	-1448.3949
7	Aut_TI	8	-1510.2989	-1468.8950
8	Aut_BEE	9	-1522.1704*	-1475.5910*

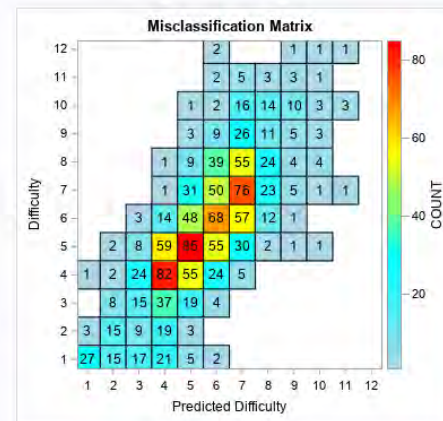
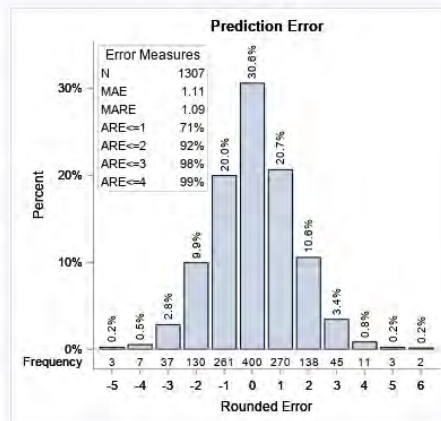
Fit Statistics	
Objective Function	725.08515
R1	0.40396
Adj R1	0.40028
AIC	-1522.17042
AICC	-1522.03163
SBC	-1475.59101
ACL	0.55477



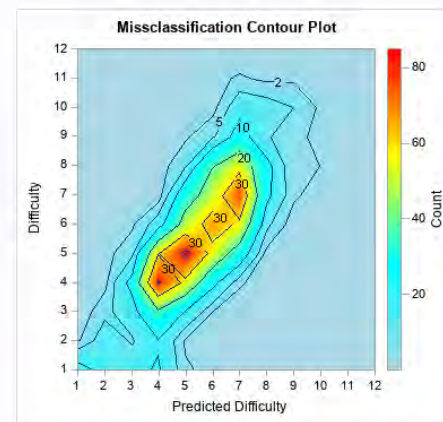
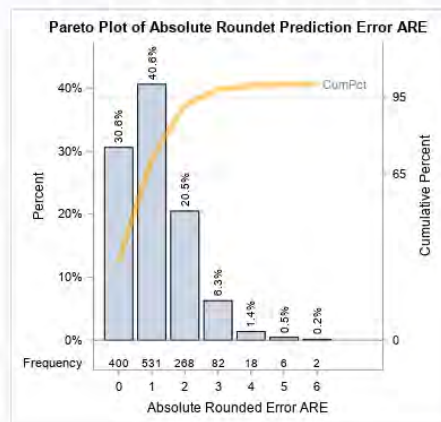
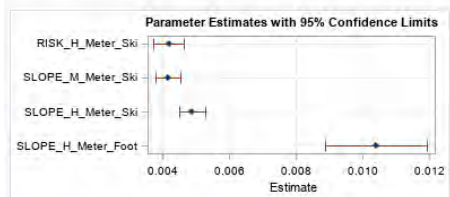
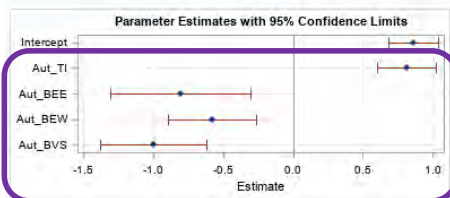
Risk:=SlopeAngle*SpeedMax

Parameter Estimates

Parameter	Estimate	StdErr	tValue
Intercept	0.85899	0.09135	9.40
Aut_TI	0.81293	0.10582	7.68
Aut_BEE	-0.80018	0.25536	-3.13
Aut_BEW	-0.57861	0.16198	-3.57
Aut_BVS	-1.00000	0.19346	-5.17
RISK_H_Meter_Ski	0.00418	0.0002401	17.41
SLOPE_M_Meter_Ski	0.00415	0.0001890	21.94
SLOPE_H_Meter_Ski	0.00488	0.0001937	25.21
SLOPE_H_Meter_Foot	0.01041	0.0007811	13.33



Four out of 12 selected author dummy variables



Significant author dummy variables

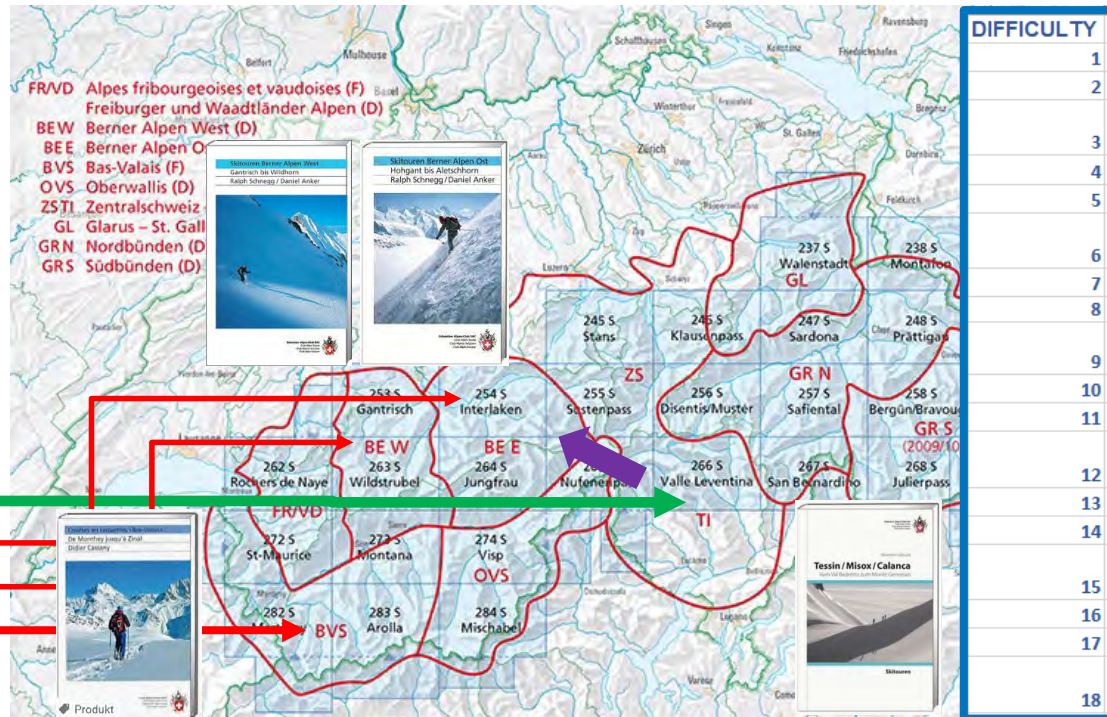
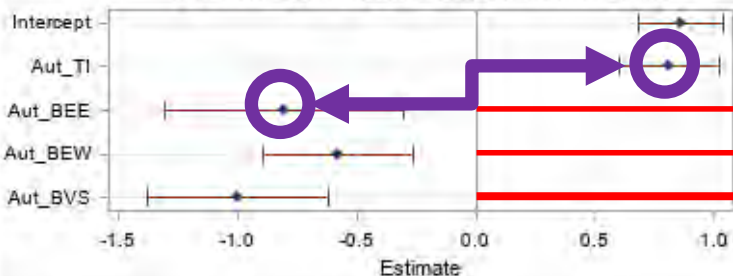
Systematic **O**verrating vs **U**nderrating bias detected for difficulty

Error Measures

N	1307
MAE	1.11
MARE	1.09
ARE<=1	71%
ARE<=2	92%
ARE<=3	98%
ARE<=4	99%

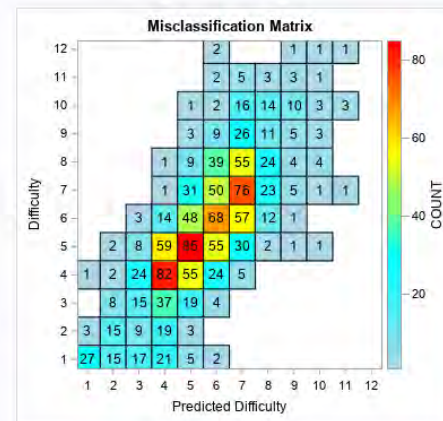
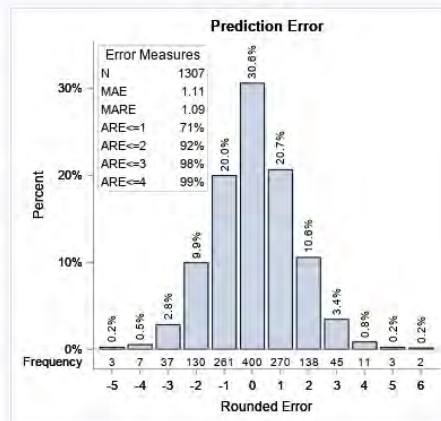
Parameter	Estimate	StdErr	tValue
Intercept	0.85899	0.09135	9.40
Aut_TI	0.81293	0.10582	7.68
Aut_BEE	-0.80018	0.25536	-3.13
Aut_BEW	-0.57861	0.16198	-3.57
Aut_BVS	-1.00000	0.19346	-5.17

Parameter Estimates with 95% Confidence Limits

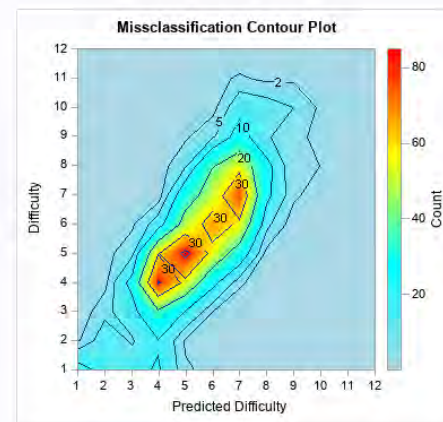
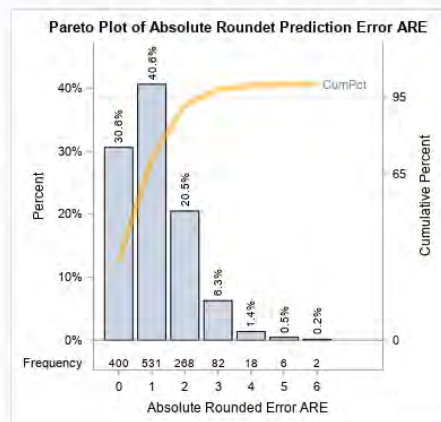
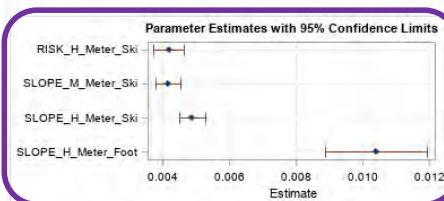
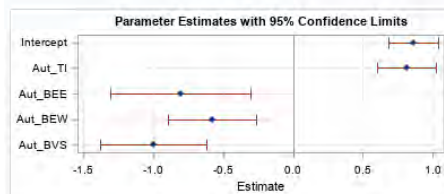


Parameter Estimates

Parameter	Estimate	StdErr	tValue
Intercept	0.85899	0.09135	9.40
Aut_TI	0.81293	0.10582	7.68
Aut_BEE	-0.80018	0.25536	-3.13
Aut_BEW	-0.57861	0.16198	-3.57
Aut_BVS	-1.00000	0.19346	-5.17
RISK_H_Meter_Ski	0.00418	0.0002401	17.41
SLOPE_M_Meter_Ski	0.00415	0.0001890	21.94
SLOPE_H_Meter_Ski	0.00488	0.0001937	25.21
SLOPE_H_Meter_Foot	0.01041	0.0007811	13.33



Selected four out of ~20 000 ski tour features derived from local track properties

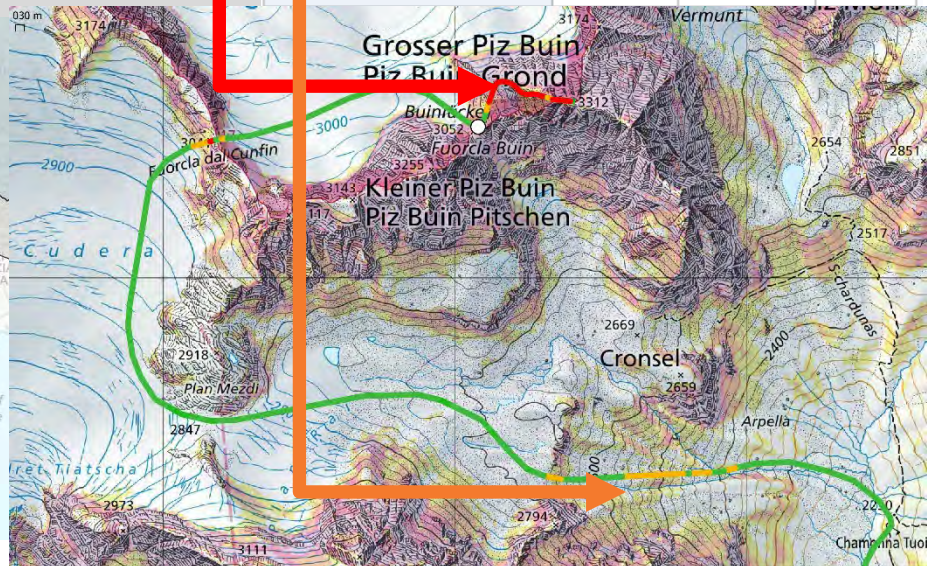
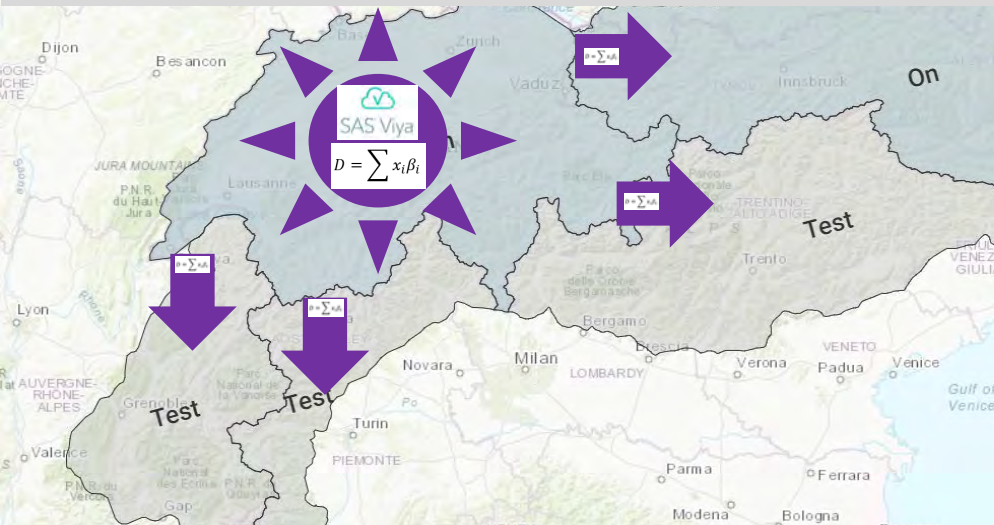


Model deployment to expand services of skitourenguru.ch to 4 neighboring countries with ~10 000 additional unrated ski tours



$$P_Difficulty = 0.859 + (418 * RISK_H_Meter_Ski + 415 * Slope_M_Meter_Ski + 488 * Slope_H_Meter_Ski + 1041 * Slope_H_Meter_Foot) / 100000$$

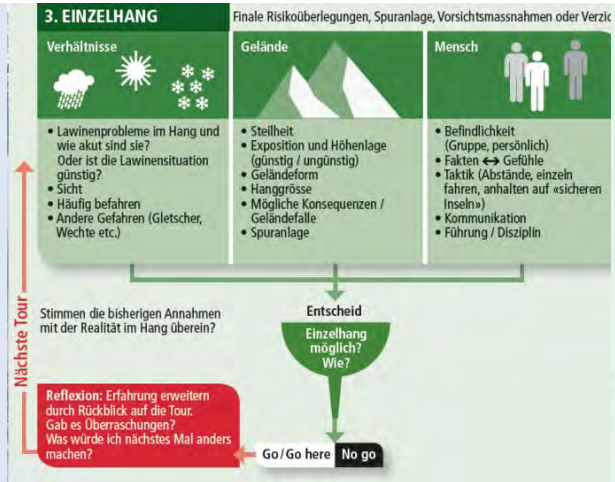
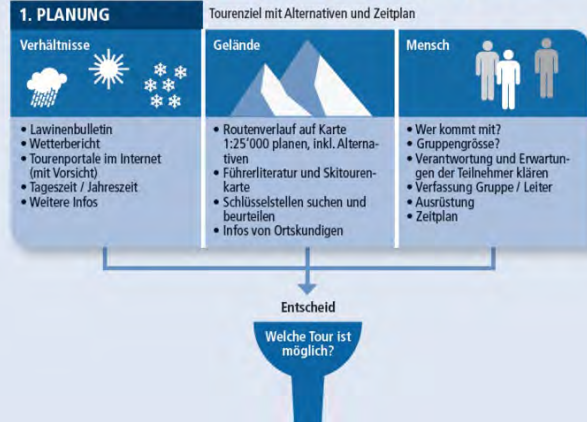
Parameter	Estimate	StdErr	tValue
Intercept	0.85899	0.09135	9.40
RISK_H_Meter_Ski	0.00418	0.0002401	17.41
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SLOPE_H_Meter_Ski	0.00488	0.0001937	25.21



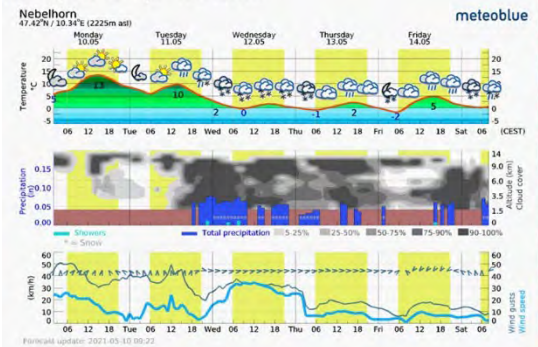


Off course, skitourenguru does not exempt you from applying the recommended avalanche and risk assessment strategies

BEURTEILUNGS- UND ENTSCHEIDUNGSRAHMEN 3X3

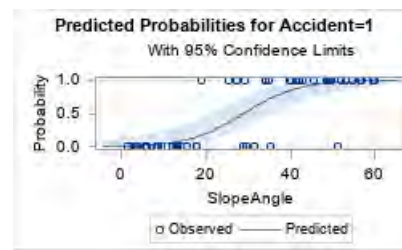


Meteogram - 5 days - Nebelhorn

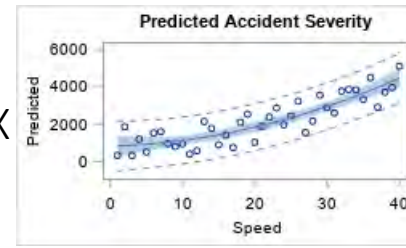


Takeaways: What did we achieve?

Difficulty \sim



X



- We are proposing a new definition of **difficulty** metric derived from interaction of two local track properties: **slope angle and speed of falling** acting as proxies for accident probability and severity
- Overall, this metric is consistent with the unique human and cultural expertise published in the extensive SAC ski touring literature from which our model was trained.
- The discretionary range of the SAC methodology and prediction error margin is in the range of 1.1 to 1.8 levels of the 18-step SAC difficulty scale (i.e. “+” or “-”)
- An additional advantage of this methodology is its independent from prevailing weather and snow conditions at the moment of manual rating.
- We still have ongoing discussions with incorporation of the foot section in this model.
- The model provides the basis for fast and automatic bulk scoring prediction for up to ~ 10000 tours throughout the alps in AT, DE, IT, FR. It will support the expansion of Skitourenguru’s services.

DIFFICULTY	DIFFICULTY LABEL
1	Easy
2	Easy (+)
3	Less Difficult(-)
4	Less Difficult
5	Less Difficult (+)
6	Quite Difficult (-)
7	Quite Difficult
8	Quite Difficult (+)
9	Difficult (-)
10	Difficult
11	Difficult (+)
12	Very Difficult (-)
13	Very Difficult
14	Very Difficult (+)
15	Extremely Difficult (-)
16	Extremely Difficult
17	Extremely Difficult (+)
18	Extremely Difficult

Günter Schmudlach, Skitouren guru GmbH, Zürich CH



Ulrich Reincke, Principal Data Scientist, SAS, Heidelberg



Thank you for your attention. And don't forget: Always put safety first

Outlier list with absolute prediction error gt 3.5

Type=Overrating

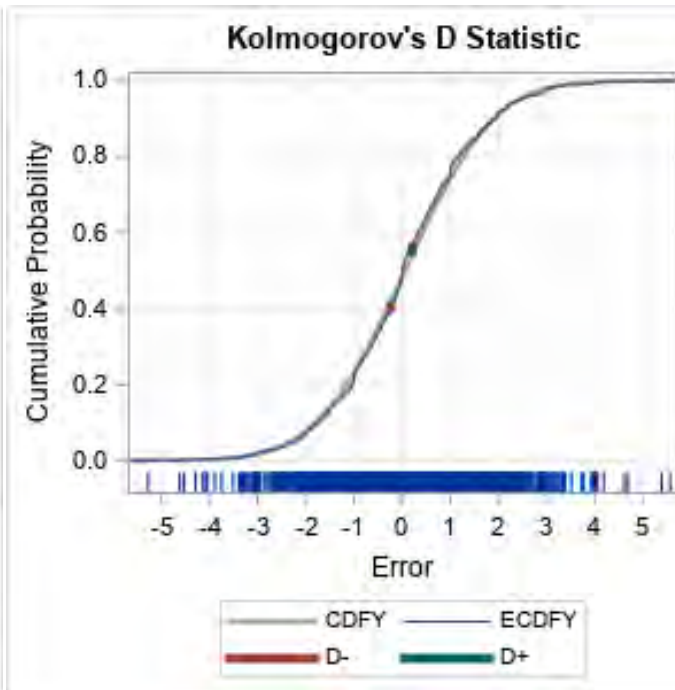
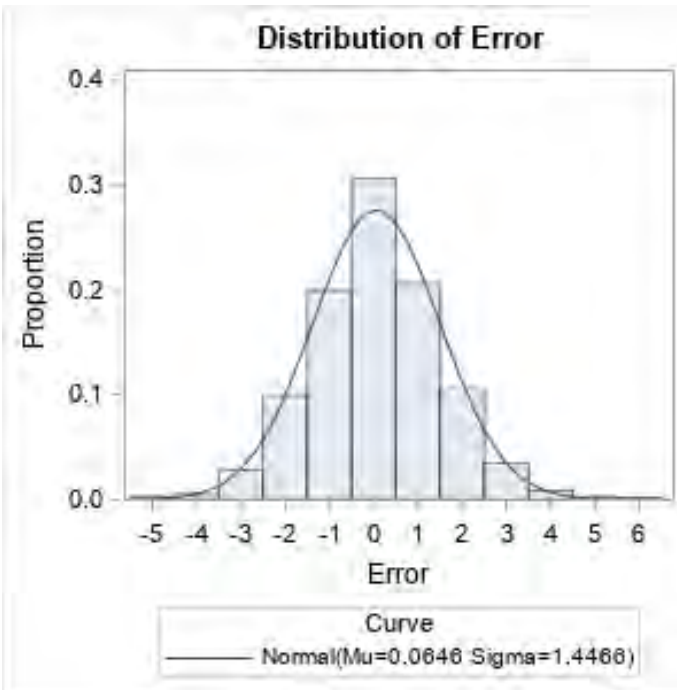
id_long	Difficulty	P	E	SAC0	Outlyer_Comment	StartEle	StopEle	Ele	RISK_H_Meter_Ski	SLOPE_H_Meter_Ski	SLOPE_M_Meter_Ski	SLOPE_H_Meter_Foot
1258_Hasen_Gotterli	1	5	-4	ZS		449	1394	945	0	748	0	0
171_Cons_PizTerri	7	11	-4	GRN		1468	3146	1789	595	748	0	360
564_Küblis_Chruz	1	5	-4	GRN	Different Route	809	2190	1384	157	372	376	0
255_Furggels_Stelli	1	5	-4	GRN	Manual Underrat	1198	2047	976	147	643	105	0
912_Mühlebach_Arnergale	1	5	-4	VSE	Different Route	1232	2621	1391	169	629	119	0
387_MittlerRossfal_Hochalp	1	5	-4	GL	Compromise	899	1527	650	234	264	484	0
535_Ladstafel_Mittaghorn	5	9	-4	VSE		1924	3004	1080	595	748	0	220
358_Latsch_CuolmdaLatsch	1	6	-5	GRS	Road above 1600	1609	2294	686	244	748	0	0
1035_HospizSimplonp_MonteLeone	5	10	-5	VSE		1998	3548	1657	508	698	50	290
1466_Sufers_VizanPintg	1	6	-5	GRN	Road above 1600	1413	2513	1120	423	748	0	0

Type=Underrating

id_long	Difficulty	P	E	SAC0	Outlyer_Comment	StartEle	StopEle	Ele	RISK_H_Meter_Ski	SLOPE_H_Meter_Ski	SLOPE_M_Meter_Ski	SLOPE_H_Meter_Foot
903_MayensdeMërib_PointedeVouasso	12	6	6	BVS		1728	3481	1755	595	748	0	0
367_ZurEich_GrosBrun	12	6	6	BEW	Compromise	951	2098	1147	595	748	0	0
1231_Engi_Gufelstock	11	6	5	GL	Compromise	812	2434	1622	260	748	0	0
706_ChantSura_PizRadönt	10	5	5	GRS	Other Ski Depot	2330	3056	751	28	120	147	300
407_Urnerboden_Läckistock	11	6	5	ZS	Compromise	1376	2483	1107	455	697	51	0
725_Dürrboden_Leidhorn	9	5	4	GRS	Compromise	2006	2930	925	150	292	456	0
507_H.d'Allières_VanildesArtses	11	7	4	FRV	Other Ski Depot	1006	1986	980	127	0	707	250
613_Diavolezza_PizCambrena	11	7	4	GRS		2978	3595	855	595	748	0	0
736_Brigels_Bifertenstock	11	7	4	GRN		1285	3416	2173	595	748	0	0
818_Jochstock_ReissendNollen	11	7	4	ZS		2508	3002	493	595	748	0	0
886_LeFlon_Chambairy	10	6	4	BVS		1046	2198	1151	595	748	0	0
916_BourgSt.Berna_MontVélan	10	6	4	BVS		1916	3721	1805	595	748	0	0
1448_Münster_Hejizwächte	9	5	4	BEE	Compromise	1387	3083	1696	323	748	0	0
1236_Elm_Grüenenspitz	9	5	4	GL	Other Ski Depot	960	2354	1394	94	316	432	60
1227_Horb_Frümsel	11	7	4	GL	Other Ski Depot	887	2261	1374	22	113	635	300
591_Tschlin_Muttler	8	4	4	GRS	Other Ski Depot	1533	3290	1758	44	22	726	30

Prediction Residuals / Error

Test for normality (N=1307)



Kolmogorov's D Statistic

The UNIVARIATE Procedure
Fitted Normal Distribution for Error

Goodness-of-Fit Tests for Normal Distribution

Test	Statistic	p Value
Kolmogorov-Smirnov D	0.03076998	Pr > D 0.168
Cramer-von Mises W-Sq	0.33496573	Pr > W-Sq 0.110
Anderson-Darling A-Sq	1.76279181	Pr > A-Sq 0.126

Kolmogorov's D Statistic

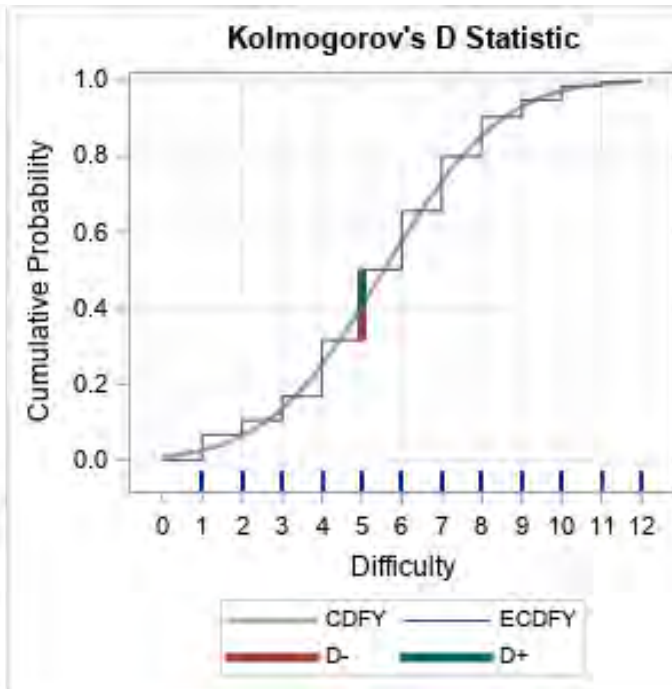
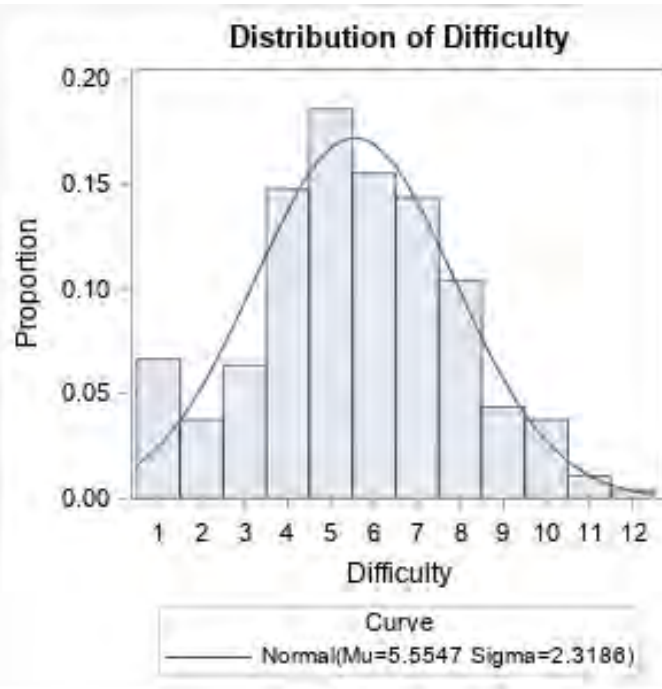
D
0.03077

Kolmogorov D

	Error	Value	Low	High
D-	-0.232248	0.0269607	0.3917368	0.4186975
D+	0.2099216	0.03077	0.5400028	0.5707728

Target Variable Difficulty

Test for normality (N=1307)



Kolmogorov's D Statistic

The UNIVARIATE Procedure
Fitted Normal Distribution for Difficulty (diff)

Goodness-of-Fit Tests for Normal Distribution

Test	Statistic	p Value
Kolmogorov-Smirnov D	0.0956892	Pr > D <0.001
Cramer-von Mises W-Sq	2.0483810	Pr > W-Sq <0.001
Anderson-Darling A-Sq	11.8013910	Pr > A-Sq <0.001

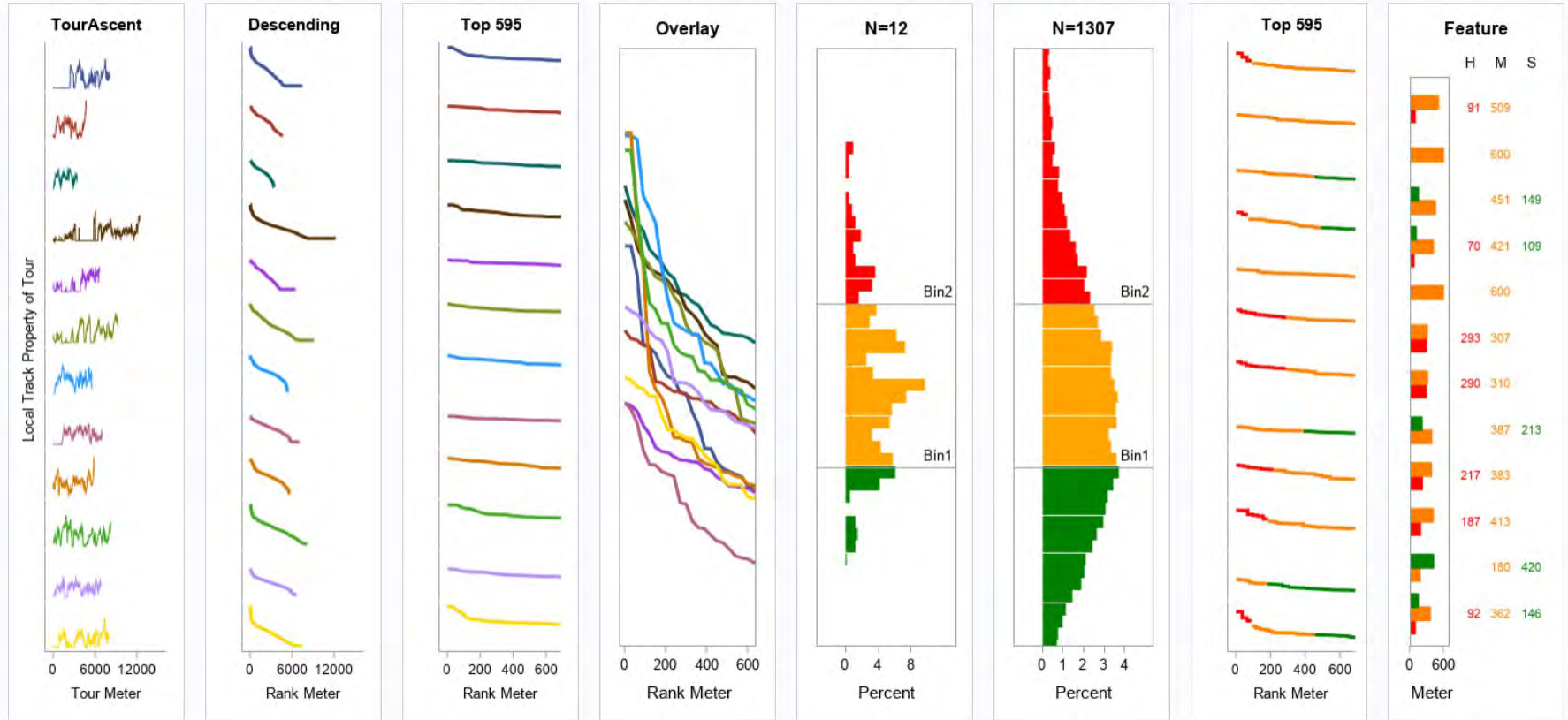
Kolmogorov's D Statistic

D
0.0956892

Kolmogorov D				
	x	Value	Low	High
D-	5	0.0902327	0.3152257	0.4054584
D+	5	0.0956892	0.4054584	0.5011477

Data preparation: from properties to features

Illustrative example of local property along four tracks



Local track properties of tours processed: Risk, Slope Angle, SpeedMax, Acceleration, Forestation, Curvature, Width,...